

Cellular Radio Interference to Denver's 800 MHz Public Safety Network



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1.0 Executive Summary

The City and County of Denver ("Denver") operates an 800 MHz EDACS trunked radio system for public safety and public utilities. The system is operated and maintained by the Electronic Engineering Bureau (EEB), an organization within the Office of Public Safety. In February of 2000, officers and firefighters started complaining of poor radio service in areas that historically had satisfactory service. Personnel from the EEB investigated and discovered that a Nextel cell site was located near each of these areas. Nextel shares the 800 MHz band with Denver and other 800 MHz users, so the potential for harmful interference was known to exist. Simple on/off tests revealed that Nextel *was* creating harmful interference at these locations, either directly or indirectly. Eventually, 24 locations were identified with harmful Nextel interference.

Subsequent to this discovery, Denver issued a formal complaint to Nextel corporate headquarters and requested that Nextel solve this problem. Over the past two years, Nextel and Denver have implemented interim fixes that have successfully reduced interference at most of the 24 locations. Interference problems persisted at several locations despite Nextel's efforts. At five of these locations, AT&T Wireless operates cell sites in close proximity to Nextel.

AT&T Wireless operates in the cellular "A" Band, immediately above the NPSPAC public safety band. AT&T has the potential to create harmful interference because of its position in the band and the wide front-ends of public safety radio receivers. Our firm was tasked to conduct an interference study to verify the contribution of AT&T Wireless and Verizon Wireless at the five locations of interest.

Field measurements and analysis show conclusively that AT&T Wireless does create harmful interference directly and indirectly at these five locations. The predominant interference is receiver intermodulation, a nonlinear mixing of interfering signals in the front-end of the public safety receiver. Although AT&T can create intermodulation interference by itself, most of the intermodulation products are created in combination with Nextel. In other words, interference is much more likely if AT&T and Nextel are co-located.

Several potential interim solutions are suggested but the least cost and most practical solution is for AT&T to limit its channel sets at the affected sectors to preclude intermodulation products on Denver's control channels.

2.0 Background

The City and County of Denver (“Denver”) operates an 800 MHz MA/COM EDACS trunked radio system for public safety and public utilities. The main repeater site is located on Mt. Morrison, in the Denver foothills, roughly 12 miles southwest of downtown Denver. A backup repeater site is co-located with the Combined Communications Centers at 950 Josephine Street. Voting (auxiliary) receivers are located at three additional locations: on the tower at Josephine Street, 1801 California Street, and the Marriott Hotel at I-25 and Hampden. To improve indoor coverage, bidirectional amplifiers are installed at the Colorado Convention Center, Denver Museum of Nature & Science, Denver Public Library, Zoological Gardens, District 5 Police Substation, Cherry Creek Mall, and the Denver Health Medical Center. The trunked radio system is operated and maintained by the Denver Electronic Engineering Bureau, a city organization that falls under the Office of Public Safety.

Denver holds FCC licenses for 48 channels. Thirty-five of these channels fall in the 854-861 MHz band. Of these original thirty-five, 20 are used for public safety and 15 are used for utilities. In the mid 1990’s, Denver requested and received licenses for thirteen NPSPAC channels (866-869, 821-824 MHz). Four of the NPSPAC channels are used for voice communications and nine are used for public safety data services. The 24 public safety voice channels are listed in Table 1.

A. The Nextel Interference Problem

In February of 2000, the EEB started receiving complaints from police officers and firefighters of poor radio service at several locations that had not historically been problem areas. Upon further investigation, the EEB discovered that a Nextel cell site was near each of these locations. Over time, a total of 24 interference sites were identified inside the City and County of Denver. Simple on/off tests showed that Nextel was in fact creating harmful interference, either directly or indirectly, at these locations. Denver formally notified Nextel corporate headquarters of the problem and asked the company to investigate and eliminate harmful interference caused by its cell sites. Over the past two years, Denver and Nextel have worked together to correct the problem. Although significant improvements have been made, there are still problems at several of the sites.

The Nextel interference problem is an example of the *near-far* problem. Radio receivers operating in the same band or in adjacent bands have limited ability to reject interference. Strong signals from 800 MHz cell sites near the public safety receiver can cause harmful interference. The relatively weak signal from the public safety repeater site, often located miles away, cannot overcome this strong interference. Usually the offending Nextel site has relatively low antenna heights, creating strong signals on the street. Denver is not unique. Many cities across the United States face the same problem.

Table 1 - Denver Public Safety Frequencies (Voice Channels Only)		
Channel	Downlink (MHz)	Uplink (MHz)
Public Safety 1	854.9875	809.9875
Public Safety 2	855.4875	810.4875
Public Safety 3	855.9875	810.9875
Public Safety 4	856.4875	811.4875
Public Safety 5	857.2375	812.2375
Public Safety 6	857.7375	812.7375
Public Safety 7	858.4875	813.4875
Public Safety 8	859.2375	814.2375
Public Safety 9	859.7375	814.7375
Public Safety 10	860.4875	815.4875
Public Safety 11	855.2375	810.2375
Public Safety 12	855.7375	810.7375
Public Safety 13	856.2375	811.2375
Public Safety 14	856.7375	811.7375
Public Safety 15	857.4875	812.4875
Public Safety 16	858.2375	813.2375
Public Safety 17	858.7375	813.7375
Public Safety 18	859.4875	814.4875
Public Safety 19	860.2375	815.2375
Public Safety 20	860.7375	815.7375
Public Safety 21	866.1875	821.1875
Public Safety 22	866.5875	821.5875
Public Safety 23	867.1250	822.1250
Public Safety 24	867.6500	822.6500

There are many types of harmful interference, including transmitter spurious emissions, receiver overload, and passive intermodulation. There are no universally accepted definitions for interference types, so it is necessary to define terms. In the case of Nextel interference, experience has shown that harmful interference occurs on the downlink (repeater site to portable) and falls into two categories:

- *Receiver intermodulation* is a non-linear combination of two or more interfering signals inside the receiver front-end.
- *Transmitter spurious emissions* comprise radio frequency energy that falls outside the assigned channel for the transmitter. Transmitter spurious emissions include carrier harmonics, transmitter intermodulation products, and broadband transmitter “noise” that is typical of digital radio transmitters.

Mathematically, an intermodulation product between two interferers with frequencies f_1 and f_2 can be represented by the following general equation:

$$f_{im} = nf_1 + mf_2$$

where n and m are non-zero integers. The order of the product is simply the sum of the absolute values of the coefficients, $|n| + |m|$. For example, two interferers operating at 861.4875 and 862.4875 will create the following third-order intermodulation product:

$$860.4875 \text{ MHz} = 2 (861.4875 \text{ MHz}) - 862.4875 \text{ MHz}$$

A simple rule of thumb for two-transmitter 3rd order products is that the products will fall exactly $|f_1 - f_2|$ below f_1 and above f_2 . Thus, a simple (but inefficient) way to eliminate receiver intermodulation is to first create a guard band between dissimilar services and then ensure frequency sets for the interfering service (e.g., Nextel) have a span no greater than the span of the guard band.

For typical public safety receivers, receiver intermodulation is not a problem unless the interfering signals exceed -50 dBm *and* the desired signal is relatively weak. Because public safety receivers have passbands that include the entire 800 MHz band (851-869 MHz), interfering Nextel signals are not attenuated at the receiver front-end.

Laboratory measurements show that 5th and higher order intermodulation products are much weaker than 3rd order products (in some cases, 25 dB weaker). Thus, it is reasonable to focus mitigation efforts solely on 3rd order products.

Some engineers use the term “receiver overload” to describe strong interfering signals at the radio receiver that do not have the mathematical relationship to create harmful intermodulation products. These interferers may compress the front-end amplifier, activate automatic gain control circuits (AGC) and degrade the receiver sensitivity. Laboratory measurements of several of Denver’s MA/COM portable and mobile receivers show that receiver overload is a minor problem and the dominant problem is receiver intermodulation. In other words, the public safety receiver is robust in the presence of a single strong interferer, but vulnerable to multiple interferers if they create intermodulation products that fall on active frequencies.

B. Interim Measures

Nextel and Denver have implemented a set of interim measures to minimize the effects of harmful interference until such time that the FCC realigns the 800 MHz band to create separation between public safety systems and cellular-type commercial systems like Nextel [9]. There are two interim measures that have been adopted:

- Elimination of Intermodulation on Control Channels. Interference on control channels is especially harmful because the officer cannot communicate unless the control channel can be decoded. If the control channel is free of interference, a call will eventually connect because of the way EDACS assigns traffic channels. The EDACS system controller sequentially steps up in the channel sequence with each push-to-talk (PTT), so if the first assigned traffic channel is unusable, the officer will connect on one of the subsequent PTTs.

It was not practical for Nextel to create channels sets at its sites that were intermodulation-free on all of Denver's 24 public safety voice channels, so Denver agreed to an interim compromise where it would operate its control channel on one of the first five public safety channels: 854.9875, 855.4875, 855.9875, 856.4875, and 857.2375 MHz. This interim measure is only a partial solution as traffic channels can still receive harmful interference.

- Elimination of Transmitter Spurious Products with Autotune Cavity Combiners. Nextel originally operated its cell sites with wideband bandpass cavity filters that covered the entire SMR band (851-866 MHz). These filters, along with Nextel's transmitter combiners, allowed Nextel to remotely change frequencies to satisfy frequency planning requirements and to minimize co-channel interference within Nextel's network. Unfortunately, the wideband filters allowed broadband transmitter spurious emissions to radiate from the site on Denver public safety channels. As a second interim measure, Nextel agreed to install autotune cavity combiners at each of the problem sites. These cavity filters have much narrower bandwidths and therefore attenuate transmitter spurious products effectively.

C. Problems Caused by the 800 MHz Cellular Operators

After implementing the interim measures described above, Denver and Nextel noticed that several of the 24 sites were still experiencing interference. Five of these sites were co-located with AT&T Wireless. Following this discovery, our firm was asked to make field and laboratory measurements to determine if AT&T or Verizon is contributing to the interference observed at these locations.

Because of their proximity to the public safety 800 MHz band, the A and B Band cellular operators can also create harmful interference. In Denver, the A Band operator is AT&T Wireless and the B Band operator is Verizon Wireless. The band allocation for the Denver metropolitan area is shown in Figure 1.

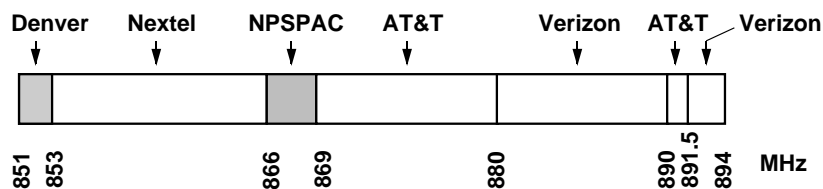


Figure 1 - 800 MHz Band Allocation in Denver

Public safety receivers have relatively wide front-ends. The best receiver measured, Model 700P, does not attenuate incoming signals below 875 MHz. Some of the older radios such as the MR-K, do not attenuate signals below 890 MHz. Much of the AT&T band will pass through the receiver front-end and potentially create intermodulation interference. It is also mathematically possible for AT&T to mix with Nextel and Verizon to create intermodulation products that fall on or near Denver frequencies.

Transmitter spurious emissions are also a potential problem for AT&T base stations because in Denver, AT&T employs a Lucent linear amplifier combiner (LAC) at its cell sites. The bandpass filter on the LAC passes some energy below 869 MHz, so radios operating on NPSPAC frequencies are vulnerable to transmitter spurious emissions from AT&T cell sites.

The three 800 MHz operators use different airlink standards that influence the type of interference they create. The relevant characteristics of the three operator systems are listed in Table 2.

Table 2 - Denver Area 800 MHz Operators (Voice Channels Only, Control & Data Channels not Included)			
	Nextel	AT&T Wireless	Verizon Wireless
Band	851-866 MHz	869-880, 890-891.5 MHz	880-890, 891.5-894 MHz
Airlink Standards	iDEN	AMPS, TDMA, GSM	AMPS, CDMA (TIA-95)
Multiple Access	TDMA	FDMA, TDMA	FDMA, CDMA
Channel Bandwidth	25 kHz	30 kHz, 200 kHz	30 kHz, 1.25 MHz
Transmitters	Always On	As Needed, Downlink Power Control, Dynamic Channel Allocation	CDMA pilot always on, Downlink Power Control

Note that Nextel's base station transmitters are continuously keyed, so interference, if it occurs, is constant. AT&T, on the other hand, only keys its transmitters when there is traffic. Thus, interference is intermittent and more difficult to reproduce. Also, AT&T employs dynamic channel allocation, so it may be difficult for the company to limit its site frequencies to intermodulation-free sets.

Although AT&T and Verizon can theoretically create harmful interference, there are mitigating factors as a consequence of their position in the band and the types of technology employed. Consider the following points:

AT&T Wireless

Factors contributing to the potential for harmful interference:

- AT&T is adjacent to NPSPAC band
- Numerous theoretical “hits” on Denver NPSPAC channels
- Numerous theoretical “hits” near 855 MHz with Nextel
- Denver receivers do not attenuate below 875 MHz
- AT&T base stations pass transmitter noise below 869 MHz

Mitigating factors:

- Measured signal levels on the street are lower than Nextel (in general)
- Location in 800 MHz band limits harmful AT&T 3rd order products
- Third-order hits in 855-858 MHz region require contribution of Nextel also
- I.e., most likely products to fall on control channels are combinations with Nextel
- Frequencies above 875 MHz attenuated (for some radios)
- Transmitters not keyed continuously

Verizon Wireless

Factors contributing to the potential for harmful interference:

- Some theoretical hits with AT&T Wireless
- Wideband CDMA signal affects many channels

Mitigating factors:

- CDMA transmitters tend to be low power & low power density
- Most Denver portables do not pass frequencies above 880 MHz
- Base stations do not pass transmitter noise below 869 MHz

D. Basic Principles

We can derive some basic principles from this discussion that will help diagnose and troubleshoot interference problems with cellular operators:

- Intermodulation interference from the A Band cellular operator (AT&T Wireless) in isolation is most likely to occur in the NPSPAC band (866-869 MHz).
- Transmitter spurious emissions from AT&T cell sites are most likely to affect NPSPAC channels.

- For mathematical reasons, 3rd order intermodulation interference to Denver's control channels (855-858 MHz) cannot originate solely from AT&T Wireless if the interferers are in the main part of the A Band (869-880 MHz). Interferers from the upper band (890-891.5 MHz) should be attenuated by the bandpass filter in the receiver front-end.
- It follows that for AT&T Wireless to contribute to intermodulation interference on Denver's control channels, another 800 MHz interferer must be present in the band between the control channel and the cellular A band. Usually, this interferer will be Nextel, especially if the interferer falls between 861 and 866 MHz. Thus, harmful interference to Denver control channels from AT&T Wireless is most likely to occur when AT&T is co-located with Nextel.
- Band separation makes interference from the B Band cellular operator (Verizon Wireless) unlikely. The number of potential intermodulation products is smaller, the public safety receiver attenuates the interfering signal, and base station bandpass filters effectively attenuate transmitter spurious emissions.

3.0 Approach ---

To accomplish the objectives of this study, we adopted the following approach:

- Collect signal strength measurements in the vicinity of each of the affected cell sites on the following channels:
 - Denver control channel
 - One AT&T control channel per sector
 - One Nextel channel per sector
 - One idle Denver channel (to serve as interference source)
- Compute the carrier-to-interference ratio (C/I) at each measurement point
 - C/I for intermodulation interference (requires measurements plus analysis)
- Plot the C/I values on digital street maps. Note locations with poor C/I .
- Conduct a desktop intermodulation study to identify candidate 3rd order intermodulation products.
- Using the results of the intermodulation study and the predicted locations of poor C/I , return to the sites with a Denver portable radio and conduct on/off tests to establish cause and effect relationships and identify sources of harmful interference.

Proper measurement of land mobile radio signals requires an understanding of multipath fading and statistical analysis. Appendix A describes the measurement methods in more detail.

The five sites with harmful interference where AT&T and Nextel are co-located¹ were furnished by Denver and are the following:

48th & Elm

Nextel: Site CO0249R , 48th & I-70,

AT&T: Site 1034, Federal & I-70

Colorado & Colfax

Nextel: CO0555R, City Park

AT&T: 1102, Colfax & Colorado

1st & University

Nextel: CO0126R, Cherry Creek

AT&T: 1015, Cherry Creek

Yale & Colorado

Nextel: CO0466R, University Hills

AT&T: 1106, Yale & Colorado

14th & Market

Nextel: CO0061R, 16th Street Mall

AT&T: 1058, Auraria

Two other sites were identified by Denver and Nextel as having persistent interference problems but were shown to not be caused by AT&T Wireless. These two sites were 41st & Colorado and Alameda & Federal. Drive test measurements showed that at each site, the nearest AT&T cell site was too far from the problem areas to create harmful interference. Something else is occurring at these two sites.

The study focused on interference to Denver's control channels, Channels 1-5.

4.0 Results of Testing and Analysis

The drive test data were analyzed to estimate the intermodulation C/I and the C/I values were plotted on digital street maps. Figure 2 is the plot for the Colorado & Colfax site. The following color code is used: $C/I > 20$ dB = **Green**, 17 dB $< C/I \leq 20$ dB = **Yellow**, $C/I \leq 17$ dB = **Red**. Note the red areas along Colorado Boulevard. These areas correlate well with the areas of interference complaints. Plots for the other sites are found in Appendix B to this report.

¹By co-located, we mean that the two cell sites are within 250 yards of each other. The cell sites do not have to occupy the same tower or rooftop to create strong signals at the the same location on the street.

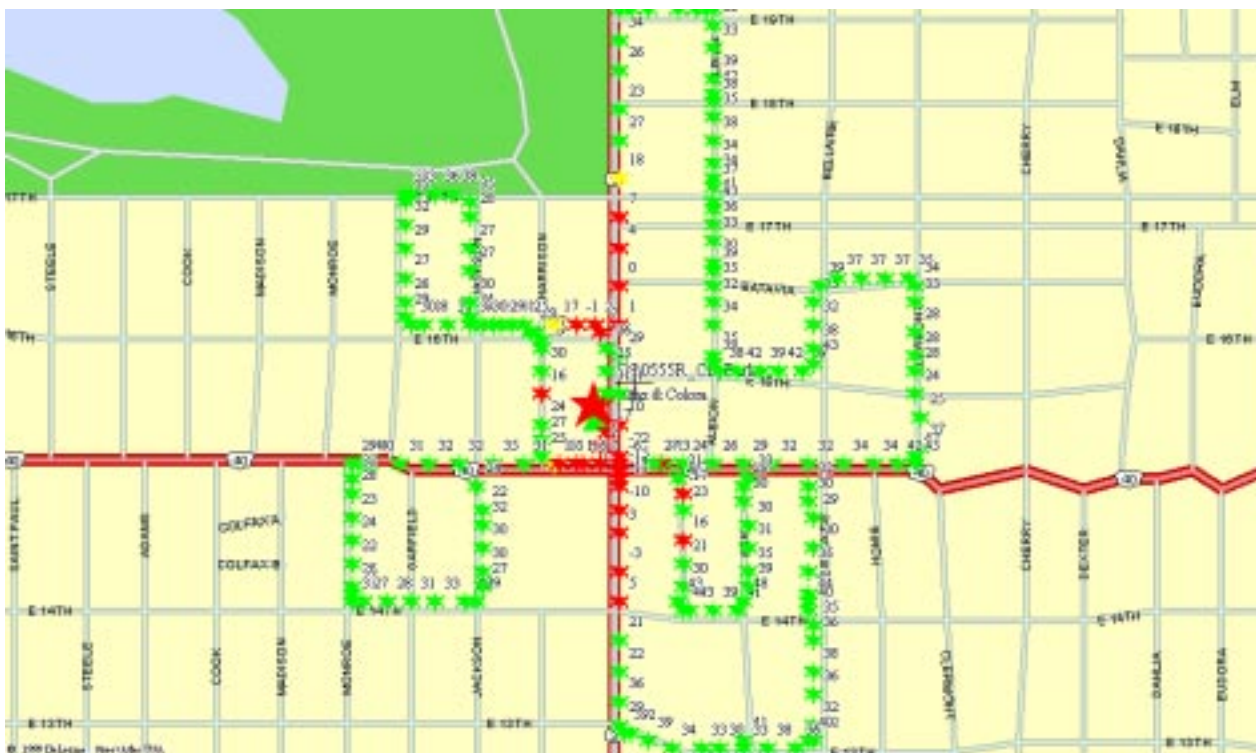


Figure 2 - Drive Test Results for Colorado & Colfax

In general, Nextel signals were stronger in the complaint areas than AT&T signals. For example, at Colorado & Yale, at those points identified as “Red” ($C/I \leq 17$ dB), the strongest Nextel signal exceeds the strongest AT&T signal by an average of 13 dB.

Most of the intermodulation products that include Nextel have the form $2A - B$ where Nextel = A and AT&T = B. Laboratory measurements of MA/COM receivers show that to reduce the amplitude of this type of intermodulation product, the interferer whose second harmonic appears in the product (“A” or Nextel) has a stronger effect on the amplitude of the intermodulation product. In other words, the amplitude of the product will be reduced more by lowering Nextel by 3 dB than it would by lowering AT&T by 3 dB. Both should be lowered to eliminate the interference, but the effects are unequal.

After the drive test plots were created, we conducted a desktop intermodulation study using AT&T frequencies for each sector of each site (furnished by AT&T) and Nextel frequencies for each sector of each site (furnished by Nextel). From this intermodulation study, a candidate 3rd order intermodulation product was selected for each offending sector at each of the sites in question. On/off tests were conducted with only the candidate signals on-the-air to ensure the cause and effect relationship was clearly established. On/off tests consisted of push-to-talk tests while walking through the area of predicted interference. The MA/COM portable radios give an audible tone (“boop”) when the control channel cannot be decoded.

For example, at Colorado & Yale, the following intermodulation product was used for on/off testing:

$$\begin{aligned} 2(863.03750) - 871.08000 &= 854.99500 \\ \text{i.e.,} \\ 2 (\text{Nextel}) - \text{AT\&T} &= \text{Denver Channel 1 (control channel)} \end{aligned}$$

This product is 7.5 kHz offset from Denver Channel 1 (854.9875 MHz). At Colorado & Yale and the other four sites, there was a clear cause and effect relationship between AT&T, Nextel, and the presence of harmful interference.

To verify that AT&T could create harmful interference by itself, we also conducted an AT&T test with three interfering signals. Again, we saw a clear cause and effect. The AT&T signals did create enough harmful intermodulation interference to preclude two-way radio service at the site.

We can safely conclude that downlink signals from AT&T cell sites at the five locations of interest contribute to harmful interference that prevents satisfactory two-way radio service (through a repeater) for the Denver trunked radio system.

5.0 Candidate Solutions

The nature of the interference leads one to suggest the following candidate interim solutions:

- Restrict AT&T Frequency Sets at Problem Sites
 - Eliminate 3rd order products alone and with Nextel
- Reduce Interference Power on the Street
 - Replace Nextel antennas (less downward radiation)
 - Replace AT&T antennas (less downward radiation)
 - Lower Nextel transmitter power
 - Lower AT&T transmitter power
 - Employ different sector orientation/split sectors/move site(s)
- Increase Denver Signal on the Street
 - Install booster amplifiers

Because the drive test results quantify the *C/I*, the amount of correction needed is roughly known at each location and the solution can be tailored to each location. Some combination of these candidate solutions may be the final result.

To better understand the power of restricting AT&T's frequency sets to be intermodulation free on Denver's control channels, consider the following real-world example:

At the AT&T Wireless cell site at Colorado & Colfax, there are 71 authorized channels used by 17 actual radio repeaters. The desktop intermodulation study reveals 530 intermodulation "hits" falling on Denver's control channels (Channels 1-5). Most hits include both AT&T Wireless and Nextel and most of these are created by AT&T frequencies that occur at the bottom and the top of AT&T's band.

Following is a hypothetical solution: First, eliminate the 27 Channels that create most of the intermodulation hits, leaving 44. The number of hits drops from 530 to 45. In other words, a 38% reduction in channels creates a 92% reduction in harmful intermodulation products.

So a possible solution might take the following form:

- Eliminate the upper (above 890 MHz) and lower (below 873 MHz) frequencies in the channel sets to reduce number of intermodulation products on the first five Denver channels.
- For sites with higher capacity needs, use custom or combined channel sets with channels from the center of the band.
- The solution can be tailored to a single relevant sector if needed so the entire site is not affected.

This approach has potential, but AT&T Wireless must assess the impact on its network performance. By reducing the number of frequencies available, the dynamic channel allocation algorithm has fewer feasible solutions when optimizing the network for maximum capacity or best quality of service. But mitigating factors are that only a handful of sectors in the City and County of Denver are affected and the number of remaining channels in the set is still large. The net effect may be negligible.

6.0 Conclusions and Recommendations

In this report, we have shown that AT&T Wireless does contribute to harmful interference at five Denver locations where officers have complained of poor radio service. This interference is a consequence of AT&T's position in the band and the cellular architecture it employs. AT&T is not unique in this regard. It is likely that most large cities in the U.S. with 800 MHz public safety radio systems are affected by Nextel and the A Band cellular operator. We have suggested some candidate interim solutions that Nextel, AT&T and Denver should jointly investigate and eventually implement. These solutions are only

partial fixes, however. The 800 MHz interference problem cannot be solved completely without a realignment of the 800 MHz band similar to the one proposed by the Consensus Parties.

At present, Nextel's interim measures only protect Denver's five public safety control channels from harmful interference. Other channels are still vulnerable. Further, even if the recommended interim solutions are implemented successfully, AT&T is likely to create harmful interference by itself in the NPSPAC band (866-869 MHz). The problem will not go away. Public safety radio and cellular radio (including Nextel) are fundamentally dissimilar services. To gain greater spectrum efficiency, cellular operators are following a trend of more cell sites and shorter cell sites. These short cell sites put strong interfering signals on the street where police officers and firefighters must operate. The public safety radio system will continue to operate from one, or at most a handful of tall sites because the economies of scale and the number of frequencies do not exist to make a cellular architecture feasible. Thus, the public safety agency will always be faced with the near-far problem.

Dissimilar services should not share radio bands.

When dissimilar services are separated, problems can still occur at band edges. For this reason, public safety should ideally occupy just one continuous band. Today, public safety shares the band from 854-861 MHz and occupies the band from 866-869 MHz (NPSPAC). Even if public safety was the sole user of 854-861 MHz, there would still be four band edges where harmful interference could occur. A better solution is to combine NPSPAC with other public safety channels in a single public safety band. Guard bands may be necessary to prevent interference at the band edges, but only one guard band would be needed if public safety is moved to the bottom of the existing SMR band (851 - 866 MHz). Essentially, this is the approach proposed by the FCC in its recent NPRM.

A separate public safety band would also allow radio vendors to design and install useful bandpass filters in receiver front-ends. These filters could eliminate the cross-band intermodulation problem between Nextel and the A Band cellular operator because signals from the A Band operator would be attenuated effectively.

7.0 References

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- [2] Telecommunications Industry Association (TIA), "A Report on Technology Independent Methodology for the Modeling, Simulation and Empirical Verification of Wireless Communications System Performance in Noise and Interference Limited Systems Operating on Frequencies between 20 and 1500 MHz," May 20, 1997.

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- [10] TIA/EIA 603B, "Land Mobile FM or PM Communications Equipment Measurement and Performance Standards," November 2002.

8.0 Engineer's Statement

800 MHz Cellular Radio Interference Study Denver, Colorado

The main conclusion of this investigation is that AT&T Wireless does contribute to harmful interference at five Denver locations where officers and firefighters have complained of poor radio service. This interference is a consequence of AT&T's position in the 800 MHz band and the cellular architecture it employs. Interference to Denver control channels is more likely to occur if the AT&T cell site is near or co-located with Nextel. We found no evidence of harmful interference from Verizon Wireless cell sites. The scope of this investigation was limited to interference locations that were first identified by the City and County of Denver. We make no conclusions regarding other locations.

We recommend that the City and County of Denver work with AT&T Wireless and Nextel to resolve this interference problem. As a first step, AT&T Wireless should attempt to limit its frequency sets on the affected sectors to preclude 3rd order intermodulation products that fall on Denver's control channels. This effort must be done in cooperation with Nextel because the principal intermodulation products include both Nextel and AT&T frequencies.

This study was conducted under my direct supervision. All representations contained herein are true to the best of my knowledge. I am a radio engineer with over twenty years experience. I hold a Bachelor of Science degree in Electrical Engineering from Virginia Tech and a Master of Science degree in Electrical Engineering from Cornell University. I am a corporate officer and stockholder of Pericle Communications Company and a Registered Professional Engineer in the State of Colorado.

Signed this 10th day of June, 2003.

- original signed & stamped -

Jay M. Jacobsmeyer, P.E.
President
Pericle Communications Company

Appendix A - Data Collection Methods and Analysis

This appendix describes the method used to collect drive test measurements in the vicinity of AT&T Wireless and Nextel co-located cell sites.

A. Measuring Fading Signals

Multipath fading is the most serious obstacle to reliable communication on the mobile radio channel, especially for indoor propagation. The mobile radio channel is rarely line-of-sight and the received signal is the sum of many reflected and diffracted signals. Fades of 40 dB or more below the mean are common.

These fluctuations are usually modeled as Rayleigh fading with Rayleigh-distributed amplitude and uniformly distributed phase. Figure A.1 is a plot of amplitude versus time for a typical Rayleigh fading mobile radio channel.

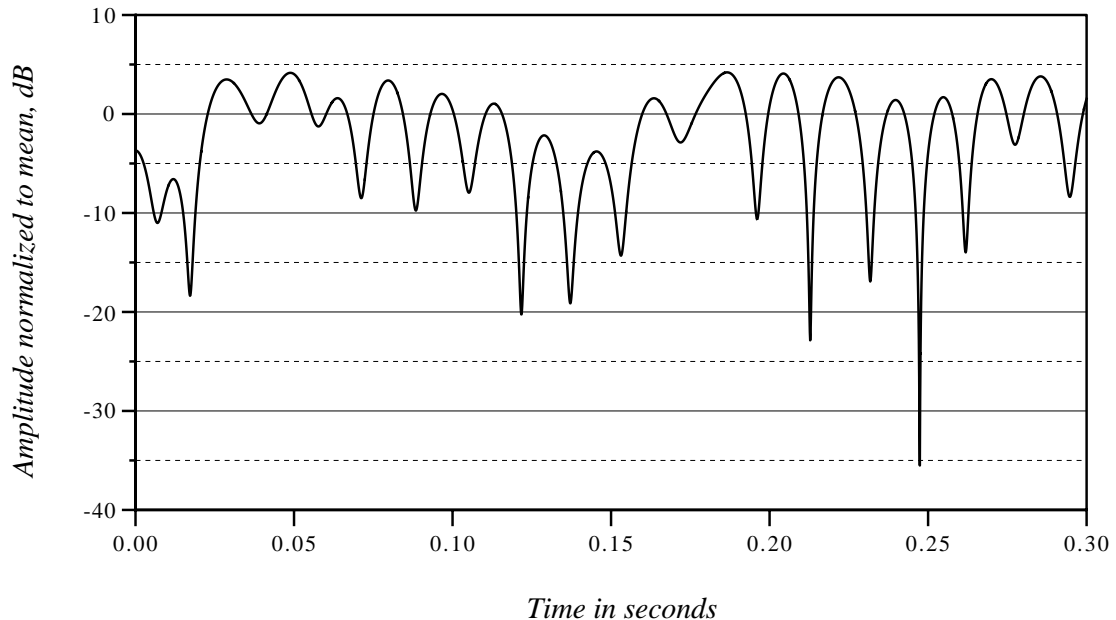


Figure A.1 - Time-Varying Amplitude on Rayleigh Fading Channel
($V = 30$ mph, $f_c = 850$ MHz)

The local mean of the Rayleigh fading signal varies more slowly than the instantaneous amplitude and is commonly referred to as *shadow loss*. The most widely used statistical model of shadow loss assumes that the loss is log-normally distributed. In other words, if the signal level is given in decibel form (e.g., dBm)², the received signal level, Y , has the normal probability density function,

²The following notation is used in this report: dBm = decibels above one milliwatt, dBi = gain in dB above an isotropic antenna, dBd = gain in dB above a half wavelength dipole.

$$f_Y(y) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(y-\mu)^2}{2\sigma^2}} \quad (\text{A.1})$$

where μ is the mean, and
 σ is the standard deviation.

In mobile radio, the standard deviation of the signal amplitude is typically 8 dB for large service areas and 6 dB for small service areas.

Mobile and portable receivers are usually specified to operate in Rayleigh fading with a minimum local mean. Thus, we want to measure the local mean, *not* the Rayleigh fading. Estimating the local mean requires that we average our measurements over some distance. The preferred distance is 40λ as it adequately smooths the Rayleigh fading [3]. Longer distances tend to include changes in the local mean due to location variability and are therefore not desirable.

B. Statistical Analysis

A minimum number of subsamples is required to get an accurate estimate of the local mean within the 40 wavelength measurement distance (roughly 40 feet at 850 MHz). The 90% confidence interval for a Rayleigh fading signal is given by

$$90\% \text{ Confidence Interval (dB)} = 20 \text{ Log} \left(1 + \left(\frac{1.65}{\sqrt{T_s}} \sqrt{\frac{4-\pi}{\pi}} \right) \right) \quad (\text{A.2})$$

where T_s is the number of subsamples. Using (2), we find that a 90% confidence interval of 1 dB requires at least 50 subsamples.

For this survey, we collected at least 50 subsamples over at least 40 feet and linear-averaged these subsamples to create each measurement sample.

The primary test instrument was the Grayson Wireless Measurement System (WMS). The particular WMS owned by Pericle Communications has four receivers: 800 MHz SMR (851-869 MHz), Cellular (869-894 MHz), PCS (1930-1990 MHz), and GPS (for position location). For this study, we used the SMR and Cellular receivers with the GPS. The Grayson is a computer-controlled test receiver capable of collecting one measurement every 10 milliseconds (100 measurements per second). Custom software is used to convert each measurement from dBm to milliwatts, average the 10 ms subsamples, and convert the result back to dBm. The averaged value and the GPS coordinates are written to a file for each measured frequency. Error checking is used to ensure each measurement covers at least 40 feet and includes at least 50 subsamples.

C. Test Equipment

Like any receiver, the Grayson WMS is susceptible to receiver intermodulation. It is important to eliminate receiver intermodulation in the test receiver so that intermodulation signals are not mistaken for over-the-air measurements. Bench testing of the Grayson revealed that two-tone 3rd-order intermodulation products rose above the system noise floor of -120 dBm when the power of each interfering signal exceeded -40 dBm. To prevent signals above -40 dBm from entering the receiver, we employed a bandpass cavity filter designed for the cellular uplink band that rolled off sharply at 855 MHz. The filter effectively attenuated most of the Nextel signals and all of the AT&T Wireless signals. We configured the Denver system to operate on Channel 1 (854.9875 MHz). To attenuate Nextel signals below 855 MHz, we employed a 20 dB attenuator. The attenuator reduced the sensitivity of the receiver, but no signals below -100 dBm were observed, so the loss of sensitivity did not affect the result.

All measurements were corrected for filter attenuation and the attenuator in post processing.

D. Analysis

A C/I value is derived from the measurements to estimate the ratio of desired signal to intermodulation interference in the public safety receiver. Calculating this ratio requires an estimate of the intermodulation product power level in the receiver. To do so, we first conducted bench top measurements of the receiver intermodulation immunity as a function of interfering signal level. Figure A.2 is an example of these measurements for the MPA and 700P portable radios.

A curve fit of the graph of Figure A.2 was created and used to translate interfering signal levels to intermodulation product power levels in the receiver. Then the ratio of the measured desired signal to the predicted intermodulation product was computed to estimate the C/I .

An industry standard for minimum C/I for 25 kHz-wide frequency modulated channels is 20 dB, corresponding to a delivered audio quality of 3.4 [2]. For this study, C/I was plotted on digital street maps using the following color code:

$C/I > 20$ dB	Green
$17 \text{ dB} < C/I \leq 20$ dB	Yellow
$C/I \leq 17$ dB	Red

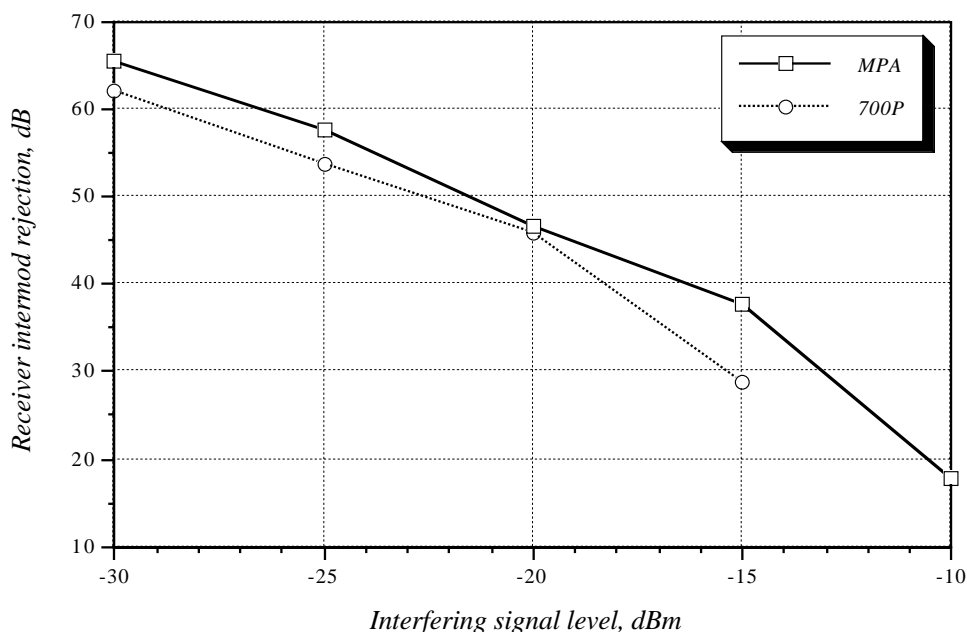


Figure A.2 - Strong Signal Receiver Intermodulation Immunity (3rd Order)

E. 5th Order Intermodulation (IM) Products

From the beginning of this investigation, the focus was on 3rd order intermodulation products. Higher order products had not been considered seriously. As a rule of thumb, 3rd order products are stronger than 5th and higher order products, but it was not known whether interference mitigation should include 5th order products. As part of this study, we measured the effect of 5th order products using TIA-603 standard signals and methods and 12 SINAD as the figure of merit [10]. Briefly, the test involved injecting two equal-power interfering signals and a desired signal through a power divider and then into the antenna port of the receiver under test. The 5th order products had the form $3A-2B$ where A is a frequency used by Nextel (861-866 MHz) and B is a frequency used by AT&T Wireless in the lower part of its band (869-875 MHz). Precautions were taken to eliminate instrument-created IM products. Given a power level for each interferer, the desired signal was increased until the SINAD value just reached 12 dB. The *IM immunity* is simply the difference (in dB) between the interfering signal and the required desired signal. A detailed test plan is available upon request.

Tests were conducted with two or three of each of the following MA/COM models: M-RK, MPA, and 700P. Figure A.3 shows the 3rd order and 5th order performance of one 700P radio. Performance for the other portable radios is similar.

Note that for interfering signals from -40 dBm to -25 dBm, the IM products fall below the sensitivity of the radio and the IM immunity is at least 89 dB. Above -25 dBm, the 5th

order product does affect performance, but the effect is much weaker than for 3rd order products. We can conclude that 5th order products are relatively weak and do not require mitigation except in extraordinary situations where interfering signals are very strong (> -25 dBm) or where there are numerous 5th order products whose effect is cumulative.

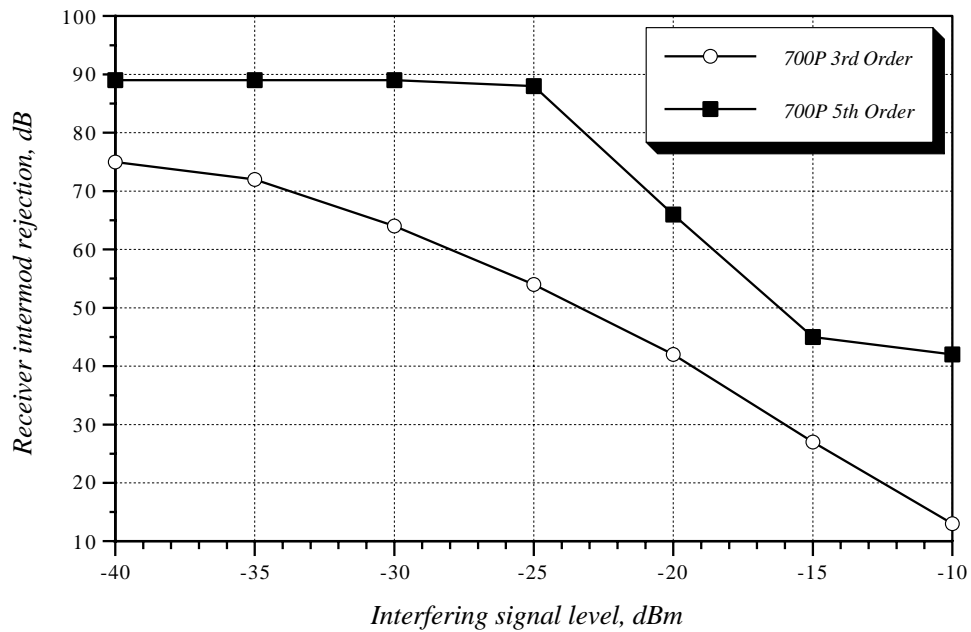


Figure A.3 - Strong Signal Receiver IM Immunity (3rd & 5th Order)

Appendix B - Plots of Drive Tests Results

$C/I > 20 \text{ dB} = \text{Green}$

$17 \text{ dB} < C/I \leq 20 \text{ dB} = \text{Yellow}$

$C/I \leq 17 \text{ dB} = \text{Red}$

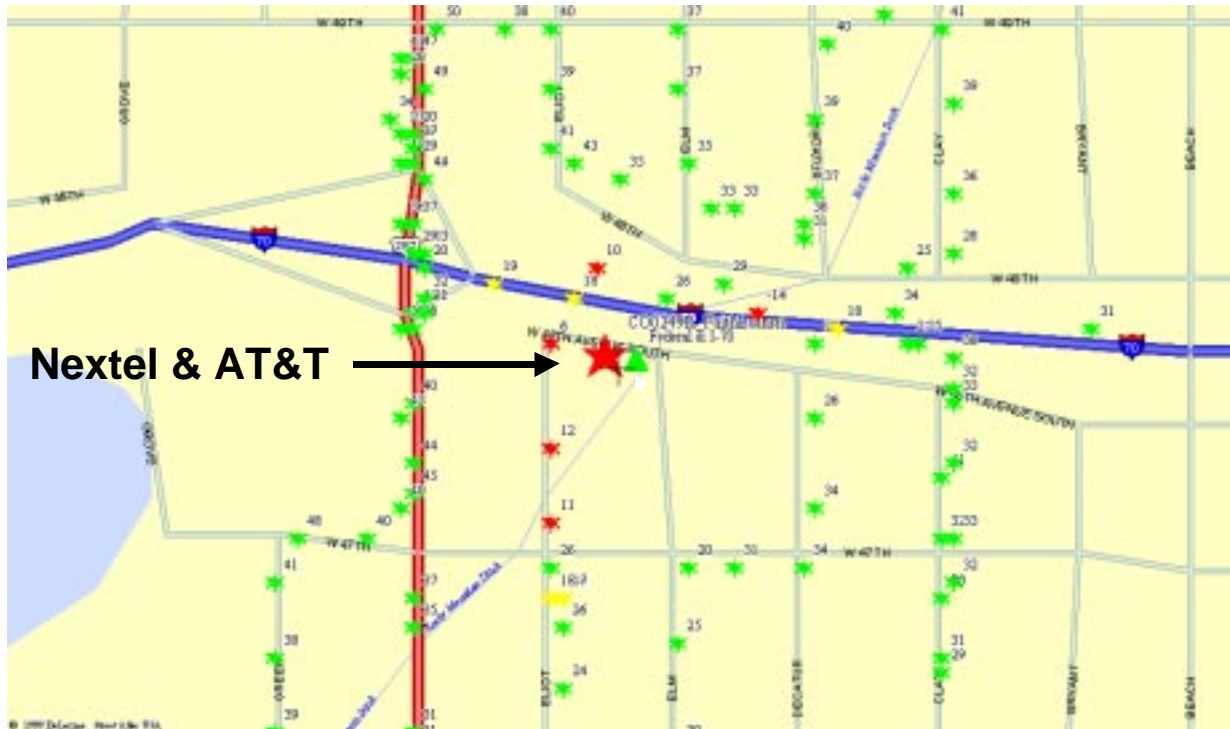


Figure B.1 - 48th & Elm



Figure B.2 - Colorado & Colfax

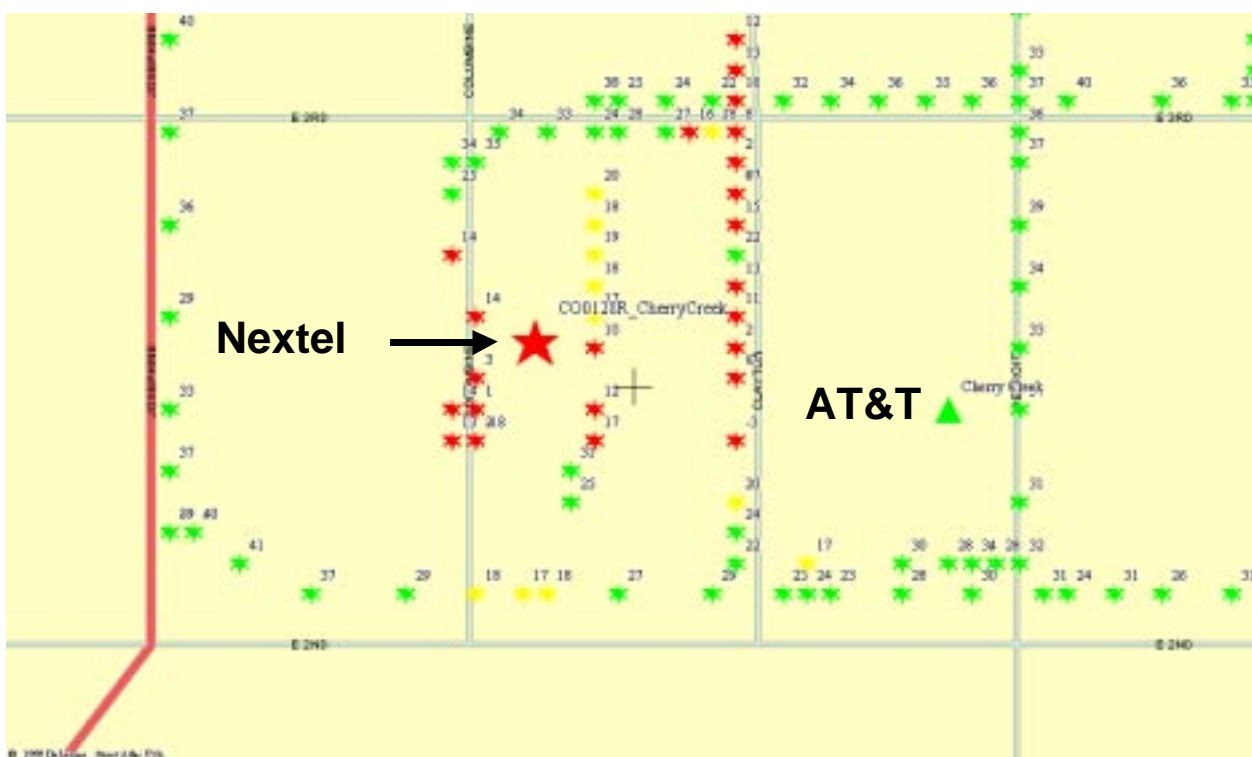


Figure B.3 - 1st & University

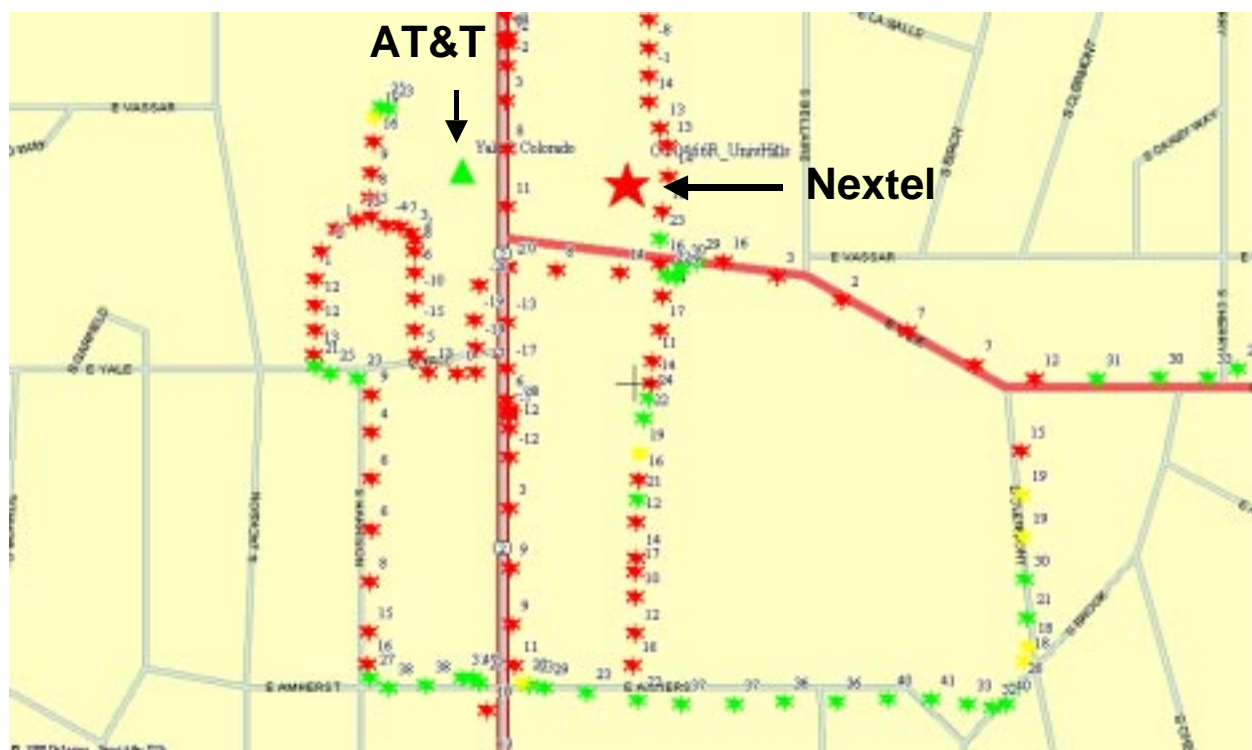


Figure B.4 - Yale & Colorado



Figure B.5 - 14th & Market

Appendix C - Measurement Data

(Also available in Microsoft Excel file)

Note: Measurements are linear averages over approximately 100 feet with at least 50 subsamples per measurement. Units are dBm. See body of report and Appendix A for further explanation of measurement collection methods. An asterisk (*) indicates a missing measurement for that frequency at that location. Latitude and longitude are in decimal degrees.

City and County of Denver 800 MHz Interference Measurements							
Site: 48th & Elm							
Pericle Communications Company							
Spring, 2003							
		Denver CCH	Nextel	Nextel	Nextel	AT&T	AT&T
Latitude	Longitude	854.9875	862.5375	864.0625	864.4125	870.0900	870.2100
39.7814	-105.0206	-89	-75	-65	-79	-90	-90
39.7818	-105.0206	-90	-71	-63	-74	-90	-90
39.7822	-105.0206	-88	-72	-58	-74	-89	-90
39.7826	-105.0206	-89	-72	-56	-74	-89	-90
39.7831	-105.0205	-87	-74	-54	-73	-86	-90
39.7834	-105.0205	-87	-69	-50	-70	-77	-84
39.7835	-105.0209	-86	-65	-44	-63	-74	-79
39.7836	-105.0215	-84	-61	-35	-62	-65	-71
39.7837	-105.0222	-80	-54	-20	-54	-56	-61
39.7838	-105.0230	-80	-53	-40	-48	-39	-56
39.7838	-105.0238	-80	-50	-56	-32	-37	-37
39.7835	-105.0240	-83	-48	-60	-28	-61	-45
39.7828	-105.0240	-84	-32	-56	-35	-69	-61
39.7823	-105.0240	-85	-32	-63	-44	-68	-66
39.7820	-105.0240	-84	-43	-65	-48	-74	-71
39.7818	-105.0240	-85	-37	-62	-46	-69	-70
39.7818	-105.0240	-85	-36	-62	-46	-69	-70
39.7818	-105.0240	-85	-36	-62	-46	-69	-70
39.7818	-105.0240	-85	-36	-62	-46	-69	-70
39.7818	-105.0240	-86	-36	-62	-46	-69	-70
39.7818	-105.0240	-85	-36	-62	-45	-69	-70
39.7818	-105.0240	-86	-36	-62	-46	-70	-70
39.7818	-105.0240	-86	-36	-63	-46	-69	-70
39.7818	-105.0240	-86	-36	-62	-46	-69	-70
39.7818	-105.0239	-85	-36	-62	-46	-70	-70
39.7818	-105.0239	-85	-36	-62	-46	-69	-70
39.7818	-105.0239	-86	-36	-62	-46	-69	-70
39.7818	-105.0239	-86	-36	-62	-46	-69	-70
39.7818	-105.0239	-87	-37	-64	-47	-69	-71
39.7816	-105.0239	-90	-49	-67	-58	-77	-74
39.7812	-105.0239	-92	-50	-68	-56	-85	-76
39.7806	-105.0239	-89	-60	-74	-64	-88	-81
39.7804	-105.0240	-85	-60	-70	-59	-86	-89
39.7803	-105.0240	-89	-61	-77	-68	-90	-90
39.7802	-105.0234	-89	-63	-80	-71	-90	-90
39.7803	-105.0229	-88	-57	-67	-67	-90	-90
39.7808	-105.0229	-90	-56	-64	-66	-84	-88
39.7815	-105.0229	-90	-48	-57	-61	-80	-87
39.7820	-105.0228	-87	-40	-50	-59	-80	-81
39.7820	-105.0224	-89	-56	-58	-68	-89	-86
39.7820	-105.0218	-87	-63	-56	-71	-90	-90
39.7824	-105.0217	-86	-63	-54	-72	-87	-90
39.7830	-105.0217	-89	-64	-48	-70	-82	-88
39.7835	-105.0217	-86	-63	-43	-64	-76	-79
39.7836	-105.0215	-83	-61	-34	-61	-64	-76
39.7835	-105.0208	-89	-66	-47	-64	-70	-74
39.7832	-105.0205	-88	-73	-55	-73	-87	-90
39.7827	-105.0205	-88	-72	-58	-74	-90	-90
39.7822	-105.0205	-87	-74	-62	-75	-90	-90
39.7819	-105.0205	-88	-75	-66	-76	-90	-90
39.7813	-105.0206	-91	-75	-69	-79	-90	-90

City and County of Denver 800 MHz Interference Measurements							
Site: 48th & Elm							
Pericle Communications Company							
Spring, 2003							
		Denver CCH	Nextel	Nextel	Nextel	AT&T	AT&T
Latitude	Longitude	854.9875	862.5375	864.0625	864.4125	870.0900	870.2100
39.7807	-105.0206	-88	-71	-68	-79	-90	-90
39.7804	-105.0206	-85	-76	-68	-79	-90	-90
39.7803	-105.0210	-90	-75	-78	-79	-90	-90
39.7803	-105.0218	-94	-71	-77	-77	-90	-90
39.7803	-105.0230	-91	-65	-79	-73	-90	-90
39.7803	-105.0242	-87	-65	-79	-68	-90	-90
39.7803	-105.0249	-86	-66	-81	-67	-90	-90
39.7803	-105.0250	-82	-65	-79	-64	-90	-87
39.7804	-105.0251	-86	-66	-80	-64	-90	-87
39.7808	-105.0252	-89	-67	-79	-64	-90	-87
39.7816	-105.0252	-84	-59	-74	-53	-85	-75
39.7825	-105.0252	-75	-65	-75	-56	-83	-74
39.7831	-105.0252	-78	-64	-75	-50	-74	-63
39.7836	-105.0252	-74	-60	-69	-44	-65	-63
39.7837	-105.0252	-72	-62	-69	-45	-62	-62
39.7837	-105.0252	-71	-60	-69	-46	-62	-63
39.7837	-105.0251	-71	-62	-69	-45	-64	-65
39.7837	-105.0251	-71	-63	-69	-45	-63	-65
39.7838	-105.0251	-76	-60	-68	-41	-63	-55
39.7841	-105.0251	-70	-57	-62	-36	-56	-45
39.7846	-105.0251	-62	-60	-62	-41	-50	-51
39.7852	-105.0251	-71	-68	-70	-52	-61	-67
39.7856	-105.0250	-68	-72	-68	-52	-61	-68
39.7856	-105.0244	-75	-63	-65	-45	-54	-68
39.7856	-105.0240	-74	-62	-58	-46	-54	-68
39.7852	-105.0240	-68	-57	-54	-40	-42	-62
39.7848	-105.0240	-68	-61	-58	-42	-42	-57
39.7847	-105.0238	-64	-58	-56	-41	-39	-59
39.7846	-105.0234	-73	-61	-47	-53	-41	-63
39.7844	-105.0226	-76	-59	-42	-54	-49	-66
39.7842	-105.0218	-75	-62	-39	-59	-61	-72
39.7840	-105.0209	-80	-68	-38	-67	-71	-79
39.7841	-105.0205	-80	-70	-41	-64	-72	-78
39.7845	-105.0205	-84	-74	-54	-70	-80	-87
39.7851	-105.0205	-81	-75	-58	-72	-80	-90
39.7856	-105.0206	-79	-76	-57	-74	-77	-89
39.7857	-105.0211	-81	-72	-56	-70	-72	-87
39.7855	-105.0216	-80	-71	-56	-73	-70	-88
39.7850	-105.0217	-78	-69	-50	-69	-68	-81
39.7845	-105.0217	-71	-63	-41	-57	-58	-70
39.7843	-105.0218	-72	-61	-41	-61	-58	-70
39.7844	-105.0224	-73	-58	-40	-54	-54	-67
39.7847	-105.0228	-72	-63	-40	-52	-46	-66
39.7852	-105.0229	-78	-64	-48	-58	-53	-74
39.7856	-105.0229	-79	-65	-49	-67	-58	-82
39.7859	-105.0229	-82	-73	-60	-72	-67	-82
39.7865	-105.0228	-86	-70	-52	-63	-66	-88
39.7871	-105.0228	-83	-68	-54	-70	-69	-90
39.7874	-105.0228	-78	-73	-55	-71	-70	-90
39.7875	-105.0231	-80	-82	-72	-77	-77	-90
39.7875	-105.0238	-80	-83	-74	-71	-76	-89
39.7875	-105.0244	-88	-84	-78	-79	-78	-90

City and County of Denver 800 MHz Interference Measurements							
Site: 48th & Elm							
Pericle Communications Company							
Spring, 2003							
		Denver CCH	Nextel	Nextel	Nextel	AT&T	AT&T
Latitude	Longitude	854.9875	862.5375	864.0625	864.4125	870.0900	870.2100
39.7875	-105.0244	-94	-83	-76	-79	-77	-90
39.7875	-105.0244	-98	-83	-76	-79	-77	-88
39.7875	-105.0244	-94	-83	-76	-79	-77	-87
39.7875	-105.0244	-95	-84	-76	-79	-76	-87
39.7875	-105.0244	-96	-84	-77	-79	-75	-90
39.7875	-105.0244	-97	-84	-78	-78	-75	-90
39.7875	-105.0244	-79	-85	-79	-73	-78	-89
39.7875	-105.0245	-80	-86	-79	-71	-77	-88
39.7875	-105.0248	-75	-80	-82	-70	-77	-87
39.7875	-105.0249	-74	-76	-82	-69	-74	-85
39.7875	-105.0249	-74	-76	-82	-69	-74	-85
39.7875	-105.0249	-74	-76	-82	-68	-74	-85
39.7875	-105.0249	-74	-77	-82	-68	-74	-86
39.7875	-105.0249	-73	-77	-82	-68	-75	-85
39.7875	-105.0249	-74	-77	-82	-68	-75	-85
39.7875	-105.0249	-73	-77	-82	-68	-74	-85
39.7876	-105.0249	-74	-78	-82	-68	-75	-86
39.7876	-105.0249	-74	-78	-82	-68	-75	-86
39.7876	-105.0249	-74	-77	-82	-68	-75	-85
39.7876	-105.0249	-74	-77	-82	-68	-74	-85
39.7876	-105.0250	-79	-83	-80	-69	-75	-84
39.7873	-105.0253	-82	-78	-78	-62	-70	-79
39.7867	-105.0253	-81	-77	-77	-61	-67	-75
39.7860	-105.0253	-70	-74	-73	-55	-67	-71
39.7854	-105.0253	-73	-66	-69	-47	-60	-62
39.7850	-105.0254	-69	-58	-57	-36	-52	-55
39.7849	-105.0253	-66	-61	-66	-41	-57	-56
39.7849	-105.0253	-66	-65	-67	-42	-60	-57
39.7849	-105.0253	-66	-65	-67	-42	-60	-58
39.7849	-105.0253	-66	-65	-70	-44	-60	-59
39.7849	-105.0253	-68	-67	-71	-43	-59	-58
39.7847	-105.0253	-63	-58	-64	-38	-53	-54
39.7843	-105.0253	-68	-57	-61	-37	-59	-52
39.7836	-105.0253	-79	-61	-70	-44	-66	-60
39.7830	-105.0253	-75	-64	-74	-51	-78	-66
39.7824	-105.0253	-80	-63	-74	-53	-83	-69
39.7822	-105.0256	-80	-63	-75	-53	-82	-70
39.7822	-105.0262	-71	-60	-79	-52	-85	-70
39.7819	-105.0264	-79	-70	-80	-60	-84	-73
39.7814	-105.0264	-82	-74	-81	-63	-90	-82
39.7809	-105.0264	-82	-73	-82	-65	-90	-83
39.7805	-105.0264	-80	-67	-81	-60	-89	-81
39.7803	-105.0263	-85	-72	-82	-66	-90	-86
39.7803	-105.0256	-88	-67	-80	-65	-90	-87
39.7804	-105.0253	-89	-67	-81	-65	-90	-85
39.7809	-105.0252	-89	-68	-79	-62	-90	-85
39.7818	-105.0252	-83	-60	-74	-56	-83	-77
39.7827	-105.0252	-77	-67	-76	-56	-81	-71
39.7837	-105.0251	-78	-62	-69	-43	-65	-56
39.7846	-105.0251	-64	-63	-63	-41	-53	-53
39.7854	-105.0252	-73	-72	-70	-54	-66	-69
39.7860	-105.0252	-71	-77	-75	-58	-68	-75

City and County of Denver 800 MHz Interference Measurements							
Site: 48th & Elm							
Pericle Communications Company							
Spring, 2003							
		Denver CCH	Nextel	Nextel	Nextel	AT&T	AT&T
Latitude	Longitude	854.9875	862.5375	864.0625	864.4125	870.0900	870.2100
-0.0167	-0.0167	-81	-81	-78	-67	-74	-80
39.7875	-105.0251	-80	-79	-78	-64	-72	-84
39.7872	-105.0253	-82	-76	-75	-61	-65	-79
39.7866	-105.0253	-80	-74	-72	-55	-66	-75
39.7859	-105.0253	-70	-64	-68	-47	-57	-69
39.7853	-105.0253	-71	-53	-52	-29	-44	-60
39.7849	-105.0253	-69	-52	-50	-29	-45	-47
39.7849	-105.0252	-68	-52	-49	-28	-43	-46
39.7848	-105.0252	-70	-54	-52	-33	-44	-45
39.7848	-105.0252	-70	-58	-61	-40	-53	-46
39.7847	-105.0252	-73	-58	-59	-35	-56	-53
39.7843	-105.0252	-63	-57	-59	-34	-59	-50
39.7841	-105.0252	-69	-60	-57	-37	-57	-44
39.7841	-105.0252	-71	-60	-58	-37	-57	-42
39.7841	-105.0252	-70	-57	-60	-36	-57	-41
39.7841	-105.0252	-70	-53	-61	-33	-60	-48
39.7840	-105.0251	-74	-50	-54	-31	-52	-43
39.7839	-105.0245	-81	-57	-50	-42	-34	-48
39.7840	-105.0236	-82	-61	-29	-56	-60	-54
39.7839	-105.0225	-82	-66	-43	-68	-74	-68
39.7837	-105.0210	-82	-71	-48	-77	-86	-78

City and County of Denver 800 MHz Interference Measurements							
Site: Colorado & Colfax							
Pericle Communications Company							
Spring, 2003							
		Denver CCH	Nextel	Nextel	Nextel	AT&T	AT&T
Latitude	Longitude	854.9875	862.7625	861.6875	863.0625	869.5800	870.1200
39.7366	-104.9385	-79	*	-66	-82	-81	-90
39.7365	-104.9385	-87	*	-69	-82	-85	-90
39.7365	-104.9389	-90	*	-71	-84	-84	-90
39.7365	-104.9392	-87	*	-67	-83	-82	-90
39.7365	-104.9397	-87	*	-68	-85	-82	-90
39.7366	-104.9401	-81	-87	-65	-86	-76	-90
39.7367	-104.9404	-79	-86	-64	-86	-76	-90
39.7367	-104.9405	-81	-86	-61	-81	-79	-89
39.7367	-104.9405	-85	*	-66	-84	-78	-90
39.7367	-104.9405	-82	*	-64	-84	-79	-90
39.7367	-104.9405	-81	-85	-59	-80	-74	-90
39.7368	-104.9406	-82	-68	-43	-69	-60	-80
39.7371	-104.9406	-77	-73	-46	-68	-64	-83
39.7375	-104.9406	-83	-69	-38	-65	-59	-81
39.7379	-104.9406	-78	-62	-33	-63	-54	-77
39.7384	-104.9406	-86	-59	-29	-66	-51	-71
39.7388	-104.9406	-90	-55	-27	-66	-50	-65
39.7393	-104.9406	-89	-61	-29	-62	-48	-72
39.7396	-104.9406	-92	-58	-26	-60	-48	-74
39.7399	-104.9406	-90	-58	-22	-59	-50	-69
39.7400	-104.9406	-90	-57	-23	-61	-50	-68
39.7400	-104.9406	-93	-56	-24	-56	-48	-64
39.7400	-104.9406	-94	-57	-25	-55	-50	-65
39.7400	-104.9406	-94	-57	-25	-56	-49	-65
39.7400	-104.9406	-91	-56	-24	-56	-48	-64
39.7400	-104.9406	-91	-57	-25	-56	-48	-64
39.7400	-104.9406	-96	-57	-25	-56	-49	-64
39.7400	-104.9406	-90	-57	-25	-57	-48	-66
39.7400	-104.9406	-90	-56	-24	-56	-49	-67
39.7401	-104.9406	-84	-58	-21	-57	-52	-70
39.7403	-104.9406	-85	-56	-20	-56	-48	-62
39.7407	-104.9406	-83	-61	-30	-53	-47	-64
39.7411	-104.9406	-84	-68	-49	-52	-48	-56
39.7416	-104.9406	-83	-67	-52	-45	-54	-53
39.7420	-104.9406	-84	-64	-53	-27	-63	-57
39.7425	-104.9406	-86	-72	-55	-27	-69	-58
39.7430	-104.9406	-86	-74	-53	-29	-69	-56
39.7434	-104.9406	-89	-76	-59	-31	-67	-58
39.7439	-104.9406	-85	-81	-52	-36	-67	-61
39.7444	-104.9406	-75	-77	-60	-36	-71	-59
39.7448	-104.9406	-76	-78	-60	-33	-71	-62
39.7453	-104.9406	-80	-76	-55	-39	-69	-61
39.7457	-104.9406	-73	-76	-57	-40	-72	-58
39.7461	-104.9406	-70	-76	-61	-42	-73	-60
39.7461	-104.9404	-72	-87	-78	-60	-89	-80
39.7461	-104.9401	-76	*	-83	-64	-90	-82
39.7461	-104.9396	-81	*	-85	-67	-90	-82
39.7461	-104.9393	-84	*	-81	-67	-90	-79
39.7461	-104.9391	-82	*	-78	-67	-87	-76
39.7461	-104.9390	-84	*	-78	-65	-86	-76
39.7459	-104.9390	-84	*	-79	-65	-83	-78
39.7456	-104.9390	-87	*	-78	-62	-85	-74

City and County of Denver 800 MHz Interference Measurements							
Site: Colorado & Colfax							
Pericle Communications Company							
Spring, 2003							
		Denver CCH	Nextel	Nextel	Nextel	AT&T	AT&T
Latitude	Longitude	854.9875	862.7625	861.6875	863.0625	869.5800	870.1200
39.7452	-104.9390	-81	*	-77	-61	-79	-73
39.7450	-104.9390	-78	*	-76	-59	-83	-75
39.7449	-104.9390	-82	*	-74	-62	-79	-74
39.7447	-104.9390	-86	-87	-72	-61	-76	-67
39.7444	-104.9390	-82	*	-76	-57	-78	-67
39.7441	-104.9390	-85	-85	-72	-52	-74	-59
39.7439	-104.9390	-82	-83	-70	-49	-71	-58
39.7438	-104.9390	-82	-82	-69	-52	-72	-60
39.7436	-104.9390	-78	-84	-69	-51	-71	-57
39.7435	-104.9390	-74	-84	-68	-53	-73	-62
39.7435	-104.9390	-77	-85	-76	-56	-72	-62
39.7433	-104.9390	-84	-84	-75	-58	-75	-65
39.7431	-104.9390	-87	-83	-78	-58	-70	-61
39.7428	-104.9390	-82	-80	-72	-45	-61	-50
39.7427	-104.9390	-81	-81	-73	-53	-68	-58
39.7425	-104.9390	-85	-81	-70	-56	-69	-62
39.7423	-104.9390	-88	-81	-67	-60	-66	-59
39.7420	-104.9390	-86	-79	-68	-55	-66	-62
39.7416	-104.9390	-86	-76	-66	-62	-60	-61
39.7415	-104.9390	-82	-73	-62	-61	-54	-55
39.7414	-104.9389	-80	-75	-63	-61	-52	-54
39.7414	-104.9386	-78	-71	-59	-55	-58	-56
39.7414	-104.9382	-81	-68	-57	-54	-58	-60
39.7414	-104.9379	-79	-77	-64	-56	-59	-58
39.7414	-104.9375	-81	-75	-66	-58	-56	-60
39.7415	-104.9373	-77	-74	-62	-61	-60	-63
39.7417	-104.9373	-83	-87	-75	-73	-73	-77
39.7420	-104.9373	-88	-87	-78	-68	-78	-75
39.7423	-104.9373	-87	-85	-75	-66	-77	-70
39.7425	-104.9372	-81	-84	-73	-64	-76	-67
39.7426	-104.9369	-83	-82	-75	-64	-72	-68
39.7426	-104.9365	-83	-84	-77	-68	-75	-74
39.7426	-104.9361	-83	-87	-76	-71	-78	-73
39.7426	-104.9357	-85	*	-79	-72	-82	-75
39.7425	-104.9356	-86	*	-82	-75	-82	-79
39.7423	-104.9356	-87	*	-85	-80	-83	-82
39.7419	-104.9356	-92	*	-85	-82	-85	-85
39.7416	-104.9356	-92	*	-80	-79	-77	-82
39.7414	-104.9356	-93	-87	-78	-67	-70	-73
39.7411	-104.9356	-96	*	-85	-82	-85	-87
39.7408	-104.9355	-95	*	-83	-84	-87	-89
39.7404	-104.9355	-83	*	-74	-84	-80	-90
39.7403	-104.9356	-73	-87	-67	-82	-78	-90
39.7402	-104.9356	-75	*	-68	-81	-77	-90
39.7402	-104.9359	-78	-85	-68	-82	-75	-88
39.7402	-104.9363	-86	-84	-64	-81	-75	-88
39.7402	-104.9368	-86	-82	-62	-77	-66	-80
39.7402	-104.9374	-88	-79	-58	-74	-65	-77
39.7402	-104.9380	-88	-78	-53	-70	-64	-77
39.7402	-104.9385	-89	-75	-51	-70	-61	-80
39.7402	-104.9390	-86	-72	-44	-66	-54	-77
39.7402	-104.9395	-87	-68	-44	-69	-53	-76

City and County of Denver 800 MHz Interference Measurements							
Site: Colorado & Colfax							
Pericle Communications Company							
Spring, 2003							
		Denver CCH	Nextel	Nextel	Nextel	AT&T	AT&T
Latitude	Longitude	854.9875	862.7625	861.6875	863.0625	869.5800	870.1200
39.7402	-104.9398	-82	-65	-38	-60	-48	-69
39.7402	-104.9399	-83	-69	-30	-54	-45	-64
39.7402	-104.9400	-76	-61	-36	-52	-43	-61
39.7402	-104.9400	-76	-60	-36	-51	-42	-61
39.7402	-104.9400	-77	-61	-37	-51	-43	-62
39.7402	-104.9406	-79	-59	-23	-59	-51	-71
39.7402	-104.9409	-87	-61	-31	-65	-53	-71
39.7402	-104.9413	-86	-58	-32	-69	-57	-76
39.7402	-104.9417	-84	-51	-36	-67	-61	-74
39.7403	-104.9419	-82	-45	-40	-63	-59	-70
39.7405	-104.9419	-80	-40	-40	-65	-59	-72
39.7407	-104.9419	-85	-42	-54	-64	-68	-73
39.7411	-104.9419	-90	-38	-57	-63	-69	-72
39.7414	-104.9419	-87	-49	-60	-57	-72	-72
39.7417	-104.9419	-88	-52	-60	-50	-75	-69
39.7418	-104.9419	-87	-53	-63	-47	-73	-66
39.7419	-104.9420	-85	-55	-61	-49	-75	-63
39.7419	-104.9421	-85	-49	-67	-43	-73	-64
39.7420	-104.9424	-88	-57	-70	-52	-79	-70
39.7420	-104.9427	-89	-51	-67	-50	-79	-69
39.7420	-104.9431	-88	-58	-72	-57	-80	-75
39.7420	-104.9435	-89	-55	-72	-64	-80	-79
39.7420	-104.9439	-92	-58	-74	-58	-77	-78
39.7420	-104.9441	-90	-57	-70	-57	-78	-83
39.7421	-104.9442	-91	-62	-77	-64	-76	-78
39.7423	-104.9442	-94	-67	-73	-71	-84	-84
39.7426	-104.9442	-93	-68	-77	-71	-87	-84
39.7430	-104.9442	-91	-72	-76	-71	-88	-86
39.7433	-104.9442	-88	-72	-78	-65	-89	-85
39.7436	-104.9442	-85	-73	-77	-64	-88	-83
39.7437	-104.9442	-98	-64	-74	-62	-83	-81
39.7437	-104.9442	-87	-63	-76	-60	-85	-82
39.7437	-104.9442	-87	-64	-75	-59	-86	-82
39.7437	-104.9442	-83	-68	-76	-63	-89	-83
39.7437	-104.9442	-86	-74	-81	-64	-89	-81
39.7437	-104.9441	-87	-78	-80	-65	-90	-82
39.7437	-104.9437	-84	-77	-81	-61	-90	-80
39.7437	-104.9434	-82	-66	-71	-57	-83	-71
39.7436	-104.9431	-85	-63	-72	-59	-84	-73
39.7434	-104.9431	-92	-68	-73	-57	-87	-77
39.7430	-104.9431	-94	-71	-79	-64	-90	-80
39.7427	-104.9431	-93	-62	-78	-60	-86	-83
39.7423	-104.9431	-90	-58	-70	-63	-83	-80
39.7421	-104.9431	-86	-53	-69	-54	-75	-71
39.7420	-104.9431	-86	-55	-73	-52	-77	-73
39.7420	-104.9429	-90	-54	-71	-54	-80	-70
39.7420	-104.9426	-90	-56	-72	-52	-77	-67
39.7420	-104.9422	-87	-54	-67	-45	-74	-65
39.7420	-104.9417	-88	-62	-68	-38	-75	-64
39.7420	-104.9413	-88	-65	-61	-28	-68	-56
39.7420	-104.9410	-85	-66	-55	-27	-60	-59
39.7419	-104.9409	-81	-61	-46	-28	-60	-54

City and County of Denver 800 MHz Interference Measurements							
Site: Colorado & Colfax							
Pericle Communications Company							
Spring, 2003							
		Denver CCH	Nextel	Nextel	Nextel	AT&T	AT&T
Latitude	Longitude	854.9875	862.7625	861.6875	863.0625	869.5800	870.1200
39.7417	-104.9408	-83	-64	-47	-42	-59	-52
39.7414	-104.9408	-86	-72	-44	-49	-55	-53
39.7411	-104.9408	-83	-65	-47	-56	-49	-63
39.7406	-104.9408	-85	-63	-35	-61	-55	-67
39.7404	-104.9409	-87	-62	-30	-63	-51	-69
39.7402	-104.9412	-86	-60	-35	-68	-55	-74
39.7402	-104.9416	-88	-55	-36	-67	-63	-76
39.7402	-104.9422	-81	-50	-45	-69	-60	-74
39.7402	-104.9427	-82	-51	-49	-74	-68	-77
39.7402	-104.9433	-88	-54	-58	-76	-72	-79
39.7402	-104.9438	-88	-56	-59	-72	-75	-78
39.7402	-104.9443	-88	-52	-59	-68	-71	-76
39.7402	-104.9448	-86	-49	-58	-71	-75	-80
39.7402	-104.9450	-80	-47	-65	-70	-70	-87
39.7402	-104.9451	-87	-48	-60	-71	-72	-83
39.7400	-104.9451	-88	-55	-63	-70	-74	-80
39.7398	-104.9451	-92	-64	-68	-80	-83	-90
39.7395	-104.9451	-97	-67	-76	-83	-89	-90
39.7392	-104.9451	-96	-71	-79	-82	-90	-90
39.7389	-104.9451	-99	-74	-74	-85	-90	-90
39.7386	-104.9451	-94	-73	-74	-86	-90	-90
39.7385	-104.9451	-94	-68	-69	-82	-82	-90
39.7384	-104.9451	-90	-74	-68	-83	-86	-90
39.7384	-104.9449	-93	-69	-65	-83	-78	-89
39.7384	-104.9445	-92	-65	-62	-78	-75	-85
39.7384	-104.9441	-90	-58	-55	-72	-67	-80
39.7384	-104.9437	-87	-67	-65	-77	-78	-90
39.7384	-104.9432	-85	-72	-68	-84	-83	-90
39.7384	-104.9430	-81	-74	-68	-80	-82	-90
39.7386	-104.9429	-93	-70	-70	-79	-85	-90
39.7388	-104.9429	-90	-71	-65	-76	-80	-89
39.7391	-104.9429	-90	-62	-63	-79	-74	-85
39.7394	-104.9429	-88	-59	-58	-76	-71	-82
39.7396	-104.9429	-89	-51	-44	-70	-64	-75
39.7399	-104.9430	-93	-51	-50	-74	-66	-78
39.7400	-104.9396	-85	-68	-39	-63	-46	-71
39.7398	-104.9395	-94	-74	-44	-61	-53	-72
39.7396	-104.9395	-93	-74	-49	-61	-55	-78
39.7392	-104.9395	-92	-66	-41	-61	-56	-76
39.7389	-104.9395	-88	-68	-43	-61	-55	-74
39.7386	-104.9395	-83	-69	-46	-66	-62	-81
39.7384	-104.9396	-73	-74	-49	-65	-61	-80
39.7383	-104.9395	-69	-74	-52	-67	-64	-82
39.7383	-104.9394	-77	-79	-57	-75	-73	-86
39.7383	-104.9390	-81	-83	-61	-80	-76	-90
39.7383	-104.9386	-79	-83	-62	-76	-76	-90
39.7384	-104.9385	-73	-83	-60	-75	-71	-90
39.7386	-104.9384	-81	-87	-61	-73	-72	-88
39.7388	-104.9384	-86	-86	-63	-74	-65	-86
39.7391	-104.9384	-89	-83	-59	-77	-66	-85
39.7394	-104.9384	-90	-82	-59	-76	-68	-82
39.7397	-104.9385	-90	-79	-56	-72	-68	-81

City and County of Denver 800 MHz Interference Measurements							
Site: Colorado & Colfax							
Pericle Communications Company							
Spring, 2003							
		Denver CCH	Nextel	Nextel	Nextel	AT&T	AT&T
Latitude	Longitude	854.9875	862.7625	861.6875	863.0625	869.5800	870.1200
39.7399	-104.9385	-89	-78	-49	-69	-61	-79
39.7400	-104.9384	-87	-73	-54	-71	-59	-78
39.7399	-104.9374	-88	-82	-61	-70	-68	-79
39.7397	-104.9374	-90	*	-69	-80	-75	-82
39.7395	-104.9373	-91	*	-68	-80	-78	-86
39.7391	-104.9373	-90	*	-70	-84	-77	-90
39.7388	-104.9374	-86	*	-70	-84	-80	-90
39.7385	-104.9374	-80	*	-67	-80	-76	-90
39.7384	-104.9374	-77	*	-69	-80	-75	-90
39.7383	-104.9374	-81	*	-66	-80	-73	-90
39.7381	-104.9373	-85	*	-70	-85	-75	-90
39.7379	-104.9373	-84	*	-70	-81	-78	-90
39.7375	-104.9373	-82	*	-71	-84	-81	-90
39.7372	-104.9373	-84	*	-71	-82	-80	-90
39.7368	-104.9373	-88	*	-70	-82	-80	-90
39.7366	-104.9373	-78	*	-68	-83	-79	-90
39.7366	-104.9374	-80	*	-74	-82	-83	-90
39.7365	-104.9376	-84	*	-73	-85	-82	-90
39.7365	-104.9381	-82	*	-70	-83	-83	-90

City and County of Denver 800 MHz Interference Measurements								
Site: 1st & University								
Pericle Communications Company								
Spring, 2003								
		Denver CCH	Nextel	Nextel	Nextel	AT&T	AT&T	AT&T
Latitude	Longitude	854.9875	862.1875	862.7625	864.3875	869.0700	870.1500	870.3000
39.7199	-104.9571	-104	-68	-50	-69	-73	-70	-55
39.7200	-104.9571	-104	-68	-51	-69	-73	-71	-55
39.7199	-104.9570	-98	-53	-25	-49	-66	-65	-45
39.7199	-104.9570	-84	-54	-28	-49	-67	-69	-47
39.7200	-104.9570	-86	-50	-28	-51	-73	-74	-51
39.7201	-104.9570	-89	-48	-30	-59	-75	-72	-52
39.7203	-104.9570	-88	-50	-36	-57	-73	-59	-41
39.7205	-104.9571	-91	-46	-37	-62	-85	-72	-56
39.7207	-104.9571	-84	-42	-46	-66	-81	-68	-57
39.7208	-104.9571	-77	-44	-53	-64	-78	-63	-54
39.7208	-104.9570	-78	-46	-46	-63	-77	-63	-54
39.7209	-104.9569	-79	-46	-49	-62	-75	-56	-46
39.7209	-104.9567	-77	-44	-56	-52	-71	-51	-47
39.7209	-104.9564	-79	-39	-53	-52	-71	-47	-51
39.7209	-104.9562	-79	-38	-57	-50	-65	-41	-48
39.7209	-104.9561	-83	-33	-57	-51	-62	-37	-48
39.7209	-104.9560	-84	-35	-56	-51	-64	-35	-51
39.7210	-104.9557	-80	-45	-62	-52	-74	-51	-60
39.7210	-104.9555	-80	-47	-68	-51	-72	-55	-65
39.7210	-104.9553	-80	-49	-65	-57	-67	-51	-72
39.7210	-104.9551	-84	-56	-65	-60	-60	-52	-72
39.7210	-104.9549	-84	-57	-64	-64	-59	-52	-72
39.7210	-104.9549	-79	-56	-62	-63	-59	-48	-72
39.7210	-104.9547	-82	-59	-66	-64	-62	-52	-75
39.7210	-104.9545	-79	-57	-71	-67	-64	-52	-78
39.7210	-104.9541	-84	-56	-69	-67	-66	-58	-79
39.7210	-104.9538	-85	-59	-70	-68	-63	-59	-78
39.7210	-104.9536	-84	-57	-71	-63	-63	-62	-78
39.7209	-104.9535	-85	-66	-75	-65	-63	-65	-79
39.7207	-104.9535	-84	-73	-76	-65	-63	-69	-83
39.7205	-104.9534	-79	-72	-76	-58	-64	-72	-81
39.7203	-104.9534	-85	-72	-73	-57	-65	-76	-82
39.7200	-104.9534	-82	-72	-71	-54	-58	-73	-79
39.7198	-104.9534	-81	-76	-65	-52	-55	-72	-77
39.7196	-104.9534	-78	-76	-67	-47	-53	-72	-71
39.7195	-104.9534	-74	-72	-69	-49	-52	-87	-71
39.7195	-104.9534	-82	-74	-63	-49	-54	-73	-74
39.7194	-104.9535	-80	-76	-64	-46	-56	-73	-76
39.7194	-104.9538	-84	-76	-63	-48	-58	-74	-72
39.7194	-104.9541	-84	-76	-61	-42	-48	-67	-68
39.7194	-104.9543	-82	-71	-60	-46	-52	-68	-70
39.7194	-104.9545	-84	-71	-61	-41	-54	-67	-71
39.7194	-104.9546	-82	-73	-59	-46	-60	-72	-71
39.7194	-104.9549	-85	-75	-58	-48	-54	-71	-69
39.7194	-104.9552	-84	-72	-55	-45	-60	-75	-65
39.7194	-104.9555	-81	-63	-55	-36	-65	-77	-61
39.7194	-104.9556	-78	-62	-52	-36	-62	-74	-55
39.7194	-104.9557	-83	-64	-53	-39	-56	-71	-49
39.7194	-104.9560	-80	-70	-47	-42	-66	-75	-57
39.7194	-104.9564	-82	-68	-41	-46	-72	-75	-56
39.7194	-104.9567	-78	-66	-32	-51	-68	-69	-49
39.7194	-104.9568	-74	-60	-29	-51	-71	-69	-48

City and County of Denver 800 MHz Interference Measurements								
Site: 1st & University								
Pericle Communications Company								
Spring, 2003								
		Denver CCH	Nextel	Nextel	Nextel	AT&T	AT&T	AT&T
Latitude	Longitude	854.9875	862.1875	862.7625	864.3875	869.0700	870.1500	870.3000
39.7194	-104.9570	-79	-60	-32	-54	-70	-70	-55
39.7194	-104.9573	-72	-71	-35	-58	-75	-73	-56
39.7194	-104.9577	-77	-78	-47	-59	-78	-78	-56
39.7195	-104.9580	-79	-73	-53	-56	-82	-83	-64
39.7196	-104.9582	-80	-70	-55	-63	-82	-81	-54
39.7196	-104.9582	-77	-76	-55	-62	-77	-75	-49
39.7196	-104.9582	-78	-78	-59	-65	-75	-74	-51
39.7196	-104.9583	-77	-76	-58	-66	-75	-75	-51
39.7196	-104.9583	-79	-72	-54	-63	-77	-74	-51
39.7196	-104.9583	-81	-67	-58	-72	-85	-82	-66
39.7198	-104.9583	-83	-67	-60	-72	-86	-83	-68
39.7200	-104.9583	-87	-65	-61	-73	-86	-83	-67
39.7203	-104.9583	-91	-60	-60	-76	-89	-81	-68
39.7206	-104.9583	-84	-60	-60	-71	-85	-73	-63
39.7209	-104.9583	-83	-58	-65	-70	-82	-68	-60
39.7212	-104.9583	-80	-60	-65	-74	-89	-75	-66
39.7215	-104.9584	-83	-58	-69	-74	-88	-73	-68
39.7219	-104.9584	-82	-57	-69	-72	-84	-68	-65
39.7222	-104.9584	-82	-48	-64	-71	-84	-65	-64
39.7225	-104.9584	-78	-40	-59	-72	-78	-59	-58
39.7240	-104.9561	-82	-57	-77	-74	-85	-63	-83
39.7240	-104.9560	-85	-56	-76	-68	-84	-62	-83
39.7238	-104.9560	-86	-57	-77	-68	-88	-60	-82
39.7235	-104.9560	-89	-55	-76	-67	-87	-60	-80
39.7232	-104.9559	-84	-52	-76	-65	-83	-60	-82
39.7230	-104.9559	-83	-52	-73	-64	-76	-62	-76
39.7227	-104.9559	-81	-50	-75	-65	-78	-58	-66
39.7226	-104.9559	-79	-52	-74	-68	-74	-58	-70
39.7225	-104.9559	-82	-47	-75	-67	-80	-51	-67
39.7222	-104.9559	-87	-54	-73	-62	-77	-49	-71
39.7220	-104.9559	-86	-44	-69	-58	-72	-44	-67
39.7217	-104.9559	-82	-43	-65	-55	-65	-36	-63
39.7214	-104.9559	-79	-37	-63	-52	-65	-32	-55
39.7212	-104.9559	-81	-39	-58	-53	-63	-30	-57
39.7211	-104.9559	-78	-40	-56	-53	-64	-29	-54
39.7210	-104.9559	-80	-41	-60	-50	-65	-32	-48
39.7209	-104.9560	-86	-26	-63	-47	-70	-44	-50
39.7207	-104.9559	-88	-39	-61	-48	-71	-53	-52
39.7206	-104.9559	-92	-45	-60	-40	-70	-52	-49
39.7204	-104.9559	-90	-52	-51	-36	-70	-58	-45
39.7201	-104.9559	-86	-56	-52	-29	-64	-66	-47
39.7199	-104.9559	-86	-60	-43	-26	-59	-68	-50
39.7197	-104.9559	-83	-59	-54	-35	-58	-70	-48
39.7196	-104.9559	-80	-62	-54	-37	-58	-69	-45
39.7195	-104.9559	-83	-65	-56	-38	-61	-75	-53
39.7195	-104.9556	-85	-67	-57	-35	-64	-76	-66
39.7195	-104.9552	-81	-73	-56	-44	-53	-69	-66
39.7195	-104.9550	-80	-74	-55	-41	-57	-71	-69
39.7195	-104.9549	-79	-73	-61	-44	-59	-73	-70
39.7195	-104.9549	-81	-78	-58	-48	-56	-77	-66
39.7195	-104.9548	-83	-73	-58	-44	-59	-73	-70
39.7195	-104.9547	-82	-70	-59	-47	-56	-69	-73

City and County of Denver 800 MHz Interference Measurements								
Site: 1st & University								
Pericle Communications Company								
Spring, 2003								
		Denver CCH	Nextel	Nextel	Nextel	AT&T	AT&T	AT&T
Latitude	Longitude	854.9875	862.1875	862.7625	864.3875	869.0700	870.1500	870.3000
39.7197	-104.9547	-85	-71	-68	-49	-51	-70	-72
39.7200	-104.9547	-86	-74	-70	-53	-56	-69	-77
39.7202	-104.9547	-87	-72	-70	-53	-53	-66	-79
39.7204	-104.9547	-86	-71	-73	-57	-56	-63	-80
39.7206	-104.9547	-81	-66	-74	-62	-58	-57	-78
39.7208	-104.9547	-81	-59	-69	-64	-59	-50	-79
39.7209	-104.9547	-81	-56	-67	-62	-61	-50	-78
39.7211	-104.9547	-83	-60	-70	-64	-66	-49	-72
39.7213	-104.9547	-83	-57	-71	-63	-72	-49	-75
39.7216	-104.9547	-87	-59	-70	-65	-70	-54	-79
39.7219	-104.9547	-90	-62	-73	-65	-74	-54	-82
39.7221	-104.9548	-82	-64	-80	-69	-82	-60	-86
39.7223	-104.9548	-83	-62	-75	-71	-79	-57	-86
39.7224	-104.9548	-79	-62	-77	-69	-77	-60	-86
39.7224	-104.9546	-82	-64	-80	-71	-81	-62	-87
39.7224	-104.9543	-81	-65	-80	-74	-85	-66	-89
39.7224	-104.9541	-79	-68	-83	-78	-90	-73	-90
39.7224	-104.9538	-77	-69	-84	-76	-89	-75	-90
39.7224	-104.9537	-77	-72	-82	-71	-82	-74	-90
39.7223	-104.9536	-84	-72	-81	-71	-85	-74	-90
39.7221	-104.9536	-88	-76	-83	-71	-80	-73	-89
39.7218	-104.9536	-89	-76	-80	-70	-76	-67	-86
39.7215	-104.9536	-80	-69	-74	-67	-69	-57	-80
39.7212	-104.9537	-82	-67	-75	-67	-67	-60	-82
39.7211	-104.9537	-86	-70	-77	-63	-63	-61	-81
39.7210	-104.9537	-83	-69	-76	-65	-59	-60	-84
39.7210	-104.9537	-84	-67	-73	-62	-57	-60	-80
39.7209	-104.9536	-85	-65	-73	-61	-65	-66	-80
39.7207	-104.9536	-85	-73	-73	-63	-61	-67	-81
39.7206	-104.9536	-84	-74	-75	-61	-62	-68	-83
39.7204	-104.9535	-79	-74	-75	-57	-63	-72	-85
39.7203	-104.9535	-85	-69	-72	-57	-65	-75	-83
39.7200	-104.9535	-82	-70	-73	-54	-63	-75	-79
39.7199	-104.9535	-82	-73	-67	-51	-56	-71	-78
39.7208	-104.9522	-85	-76	-77	-69	-69	-75	-86
39.7206	-104.9522	-86	-77	-81	-70	-68	-75	-84
39.7204	-104.9522	-88	-82	-80	-67	-74	-81	-90
39.7202	-104.9522	-82	-81	-78	-60	-70	-83	-85
39.7199	-104.9522	-86	-80	-77	-65	-72	-85	-87
39.7197	-104.9522	-84	-82	-77	-61	-64	-81	-83
39.7196	-104.9522	-78	-80	-70	-52	-67	-82	-79
39.7195	-104.9523	-86	-81	-65	-51	-60	-80	-76
39.7195	-104.9525	-77	-80	-63	-52	-60	-80	-73
39.7195	-104.9528	-81	-78	-64	-52	-59	-76	-78
39.7195	-104.9530	-81	-77	-62	-47	-58	-75	-69
39.7195	-104.9531	-79	-76	-61	-48	-59	-78	-72
39.7195	-104.9532	-78	-77	-61	-46	-57	-78	-74
39.7196	-104.9533	-79	-75	-63	-47	-59	-75	-75
39.7197	-104.9534	-80	-74	-67	-53	-55	-73	-76
39.7199	-104.9534	-82	-73	-67	-50	-53	-74	-77
39.7200	-104.9534	-81	-68	-72	-53	-60	-73	-80
39.7201	-104.9534	-80	-69	-73	-56	-60	-75	-81

City and County of Denver 800 MHz Interference Measurements								
Site: 1st & University								
Pericle Communications Company								
Spring, 2003								
		Denver CCH	Nextel	Nextel	Nextel	AT&T	AT&T	AT&T
Latitude	Longitude	854.9875	862.1875	862.7625	864.3875	869.0700	870.1500	870.3000
39.7203	-104.9534	-80	-71	-73	-61	-64	-72	-83
39.7205	-104.9534	-82	-70	-77	-60	-64	-68	-82
39.7207	-104.9535	-85	-70	-74	-62	-62	-68	-80
39.7207	-104.9535	-86	-69	-76	-59	-63	-65	-78
39.7208	-104.9535	-87	-67	-74	-65	-63	-66	-82
39.7209	-104.9535	-87	-66	-75	-63	-66	-65	-80
39.7210	-104.9535	-83	-67	-74	-64	-60	-60	-80
39.7212	-104.9535	-85	-67	-74	-68	-68	-62	-82
39.7215	-104.9535	-77	-67	-74	-68	-67	-58	-81
39.7217	-104.9535	-89	-73	-80	-67	-71	-61	-83
39.7219	-104.9535	-91	-77	-82	-67	-78	-71	-88
39.7222	-104.9535	-87	-73	-82	-74	-80	-73	-90
39.7223	-104.9535	-88	-70	-79	-69	-82	-78	-90
39.7201	-104.9559	-86	-54	-50	-25	-69	-64	-45
39.7202	-104.9559	-86	-48	-47	-28	-69	-60	-48
39.7203	-104.9559	-91	-48	-52	-35	-68	-53	-44
39.7205	-104.9559	-88	-43	-58	-47	-70	-52	-51
39.7207	-104.9559	-88	-28	-62	-47	-74	-49	-54
39.7208	-104.9559	-84	-27	-62	-45	-73	-36	-54
39.7209	-104.9559	-83	-29	-67	-41	-78	-34	-59
39.7209	-104.9560	-80	-33	-61	-48	-67	-35	-49
39.7210	-104.9560	-81	-40	-58	-47	-65	-36	-52
39.7210	-104.9562	-78	-35	-57	-49	-67	-42	-52
39.7210	-104.9564	-78	-36	-54	-51	-70	-46	-51
39.7210	-104.9565	-79	-38	-52	-53	-65	-44	-49
39.7210	-104.9565	-78	-41	-52	-50	-70	-52	-52
39.7209	-104.9565	-86	-43	-58	-53	-77	-57	-53
39.7207	-104.9565	-94	-47	-59	-52	-77	-67	-47
39.7206	-104.9565	-92	-46	-50	-49	-70	-58	-42
39.7205	-104.9565	-91	-45	-43	-49	-73	-60	-43
39.7204	-104.9565	-88	-45	-49	-45	-68	-64	-39
39.7203	-104.9565	-86	-42	-46	-41	-65	-60	-36
39.7202	-104.9565	-89	-52	-33	-42	-65	-63	-36
39.7200	-104.9565	-86	-54	-32	-44	-62	-60	-36
39.7199	-104.9565	-86	-59	-47	-40	-58	-57	-36
39.7198	-104.9566	-78	-60	-49	-42	-71	-67	-49
39.7197	-104.9566	-73	-60	-38	-48	-73	-74	-56
39.7197	-104.9566	-80	-57	-38	-43	-73	-78	-53

City and County of Denver 800 MHz Interference Measurements							
Site: Yale & Colorado							
Pericle Communications Company							
Spring, 2003							
		Denver CCH	Nextel	Nextel	Nextel	AT&T	AT&T
Latitude	Longitude	854.9875	852.4125	863.4125	865.4375	870.2100	870.6000
39.6671	-104.9363	-99	-47	-65	-53	-63	-84
39.6668	-104.9363	-101	-56	-65	-53	-70	-86
39.6665	-104.9363	-101	-58	-65	-53	-75	-88
39.6662	-104.9363	-90	-57	-65	-53	-72	-88
39.6660	-104.9362	-99	-61	-65	-53	-73	-88
39.6658	-104.9362	-102	-56	-65	-53	-74	-90
39.6657	-104.9363	-102	-61	-65	-53	-78	-90
39.6655	-104.9363	-94	-60	-65	-53	-65	-90
39.6654	-104.9364	-80	-54	-65	-53	-65	-89
39.6654	-104.9365	-79	-43	-65	-53	-61	-84
39.6654	-104.9367	-78	-44	-64	-53	-64	-85
39.6654	-104.9371	-79	-55	-65	-53	-65	-85
39.6654	-104.9374	-81	-57	-65	-53	-74	-88
39.6654	-104.9379	-84	-62	-65	-53	-76	-90
39.6654	-104.9383	-84	-69	-65	-53	-75	-90
39.6654	-104.9387	-83	-67	-65	-53	-73	-89
39.6654	-104.9392	-84	-69	-65	-53	-65	-84
39.6654	-104.9395	-89	-58	-65	-44	-58	-79
39.6655	-104.9400	-94	-63	-65	-51	-63	-83
39.6655	-104.9403	-88	-69	-65	-50	-60	-80
39.6655	-104.9405	-92	-67	-64	-48	-50	-69
39.6656	-104.9405	-90	-67	-63	-43	-49	-72
39.6657	-104.9406	-96	-67	-65	-40	-53	-72
39.6659	-104.9406	-98	-67	-63	-40	-52	-68
39.6663	-104.9406	-101	-66	-63	-43	-45	-68
39.6667	-104.9406	-97	-64	-64	-33	-41	-67
39.6670	-104.9406	-97	-64	-63	-27	-38	-67
39.6672	-104.9406	-97	-62	-63	-27	-39	-62
39.6673	-104.9406	-97	-62	-59	-29	-39	-61
39.6673	-104.9406	-100	-64	-57	-30	-38	-61
39.6673	-104.9406	-107	-60	-56	-28	-37	-60
39.6673	-104.9406	-107	-61	-56	-27	-36	-60
39.6673	-104.9406	-107	-61	-56	-27	-36	-60
39.6673	-104.9406	-100	-61	-57	-30	-38	-60
39.6674	-104.9407	-91	-63	-59	-32	-38	-64
39.6676	-104.9407	-93	-63	-62	-24	-40	-62
39.6679	-104.9407	-98	-66	-56	-27	-45	-58
39.6683	-104.9407	-99	-63	-56	-29	-36	-61
39.6687	-104.9407	-94	-65	-53	-38	-48	-47
39.6690	-104.9407	-102	-67	-45	-43	-55	-45
39.6694	-104.9407	-96	-71	-43	-46	-52	-33
39.6696	-104.9407	-92	-69	-42	-44	-55	-29
39.6697	-104.9407	-94	-66	-38	-42	-57	-30
39.6698	-104.9407	-96	-73	-40	-46	-56	-30
39.6698	-104.9406	-96	-72	-38	-49	-52	-31
39.6698	-104.9406	-95	-80	-40	-48	-53	-31
39.6698	-104.9407	-94	-79	-39	-46	-54	-30
39.6698	-104.9407	-95	-79	-38	-49	-54	-31
39.6698	-104.9407	-96	-79	-41	-51	-55	-32
39.6698	-104.9407	-97	-70	-40	-44	-59	-32
39.6699	-104.9407	-94	-69	-37	-45	-63	-46
39.6702	-104.9407	-100	-69	-35	-46	-64	-50

City and County of Denver 800 MHz Interference Measurements							
Site: Yale & Colorado							
Pericle Communications Company							
Spring, 2003							
		Denver CCH	Nextel	Nextel	Nextel	AT&T	AT&T
Latitude	Longitude	854.9875	852.4125	863.4125	865.4375	870.2100	870.6000
39.6705	-104.9407	-92	-74	-41	-51	-63	-49
39.6709	-104.9406	-97	-74	-39	-53	-68	-52
39.6712	-104.9406	-101	-76	-41	-53	-73	-53
39.6715	-104.9406	-103	-75	-43	-53	-69	-57
39.6718	-104.9406	-103	-76	-38	-53	-73	-61
39.6719	-104.9404	-103	-81	-49	-53	-73	-54
39.6719	-104.9401	-103	-76	-42	-53	-80	-56
39.6719	-104.9398	-104	-73	-36	-53	-73	-56
39.6719	-104.9396	-103	-73	-37	-53	-72	-55
39.6719	-104.9393	-97	-78	-52	-53	-76	-59
39.6719	-104.9389	-91	-71	-52	-53	-84	-68
39.6719	-104.9386	-93	-59	-39	-53	-84	-66
39.6721	-104.9385	-100	-60	-35	-53	-84	-65
39.6724	-104.9385	-102	-59	-36	-53	-84	-68
39.6727	-104.9385	-101	-61	-42	-53	-86	-70
39.6730	-104.9385	-99	-70	-50	-53	-86	-72
39.6732	-104.9385	-93	-62	-52	-53	-86	-73
39.6733	-104.9386	-82	-68	-53	-53	-87	-72
39.6734	-104.9388	-84	-75	-58	-53	-89	-73
39.6734	-104.9391	-87	-77	-60	-53	-87	-72
39.6733	-104.9394	-88	-81	-58	-53	-80	-64
39.6733	-104.9396	-86	-82	-52	-53	-82	-64
39.6732	-104.9396	-97	-81	-52	-53	-82	-65
39.6733	-104.9395	-94	-83	-57	-53	-78	-62
39.6733	-104.9393	-86	-81	-57	-53	-84	-68
39.6733	-104.9390	-82	-79	-60	-53	-88	-73
39.6733	-104.9387	-81	-74	-59	-53	-87	-72
39.6733	-104.9386	-82	-66	-52	-53	-86	-72
39.6733	-104.9383	-80	-67	-48	-53	-86	-71
39.6733	-104.9379	-79	-81	-61	-53	-89	-76
39.6733	-104.9374	-79	-81	-59	-53	-88	-73
39.6734	-104.9371	-79	-83	-62	-53	-90	-75
39.6733	-104.9369	-92	-79	-63	-53	-89	-70
39.6731	-104.9368	-102	-78	-63	-53	-87	-71
39.6727	-104.9369	-103	-77	-61	-53	-87	-73
39.6723	-104.9369	-102	-72	-57	-53	-86	-70
39.6720	-104.9369	-94	-71	-56	-53	-85	-67
39.6719	-104.9370	-82	-71	-54	-53	-85	-66
39.6719	-104.9373	-83	-76	-54	-53	-84	-65
39.6719	-104.9376	-83	-75	-52	-53	-84	-65
39.6719	-104.9381	-86	-70	-45	-53	-83	-63
39.6719	-104.9385	-89	-62	-43	-53	-84	-66
39.6719	-104.9389	-91	-70	-53	-53	-83	-66
39.6719	-104.9392	-95	-75	-50	-53	-76	-60
39.6719	-104.9394	-97	-72	-38	-53	-71	-54
39.6718	-104.9395	-101	-72	-36	-53	-68	-53
39.6717	-104.9395	-101	-72	-39	-53	-70	-51
39.6715	-104.9395	-102	-75	-35	-53	-67	-46
39.6714	-104.9395	-95	-71	-35	-53	-66	-45
39.6712	-104.9395	-91	-64	-41	-53	-65	-44
39.6710	-104.9395	-88	-65	-36	-53	-66	-39
39.6708	-104.9395	-88	-64	-43	-53	-66	-42

City and County of Denver 800 MHz Interference Measurements							
Site: Yale & Colorado							
Pericle Communications Company							
Spring, 2003							
		Denver CCH	Nextel	Nextel	Nextel	AT&T	AT&T
Latitude	Longitude	854.9875	852.4125	863.4125	865.4375	870.2100	870.6000
39.6706	-104.9395	-85	-68	-38	-53	-68	-43
39.6705	-104.9395	-89	-67	-29	-53	-66	-38
39.6703	-104.9395	-92	-62	-28	-53	-67	-43
39.6701	-104.9395	-88	-62	-28	-53	-65	-43
39.6699	-104.9395	-90	-62	-27	-53	-64	-43
39.6697	-104.9395	-90	-62	-26	-53	-64	-45
39.6695	-104.9395	-89	-63	-28	-53	-64	-46
39.6693	-104.9394	-93	-58	-40	-53	-64	-52
39.6692	-104.9394	-98	-58	-44	-53	-64	-57
39.6691	-104.9393	-98	-58	-44	-53	-61	-57
39.6689	-104.9393	-106	-54	-55	-53	-62	-69
39.6686	-104.9393	-103	-49	-53	-53	-59	-72
39.6685	-104.9394	-88	-44	-56	-50	-52	-71
39.6683	-104.9394	-94	-45	-57	-49	-43	-70
39.6681	-104.9393	-97	-46	-59	-50	-44	-68
39.6679	-104.9394	-95	-45	-60	-49	-47	-66
39.6677	-104.9394	-100	-44	-61	-49	-49	-64
39.6675	-104.9394	-100	-46	-63	-52	-52	-76
39.6674	-104.9395	-90	-47	-65	-51	-50	-71
39.6673	-104.9395	-94	-55	-65	-49	-59	-67
39.6671	-104.9395	-94	-53	-64	-47	-56	-80
39.6669	-104.9395	-94	-51	-65	-43	-50	-79
39.6668	-104.9395	-90	-55	-64	-44	-43	-78
39.6666	-104.9396	-98	-55	-65	-47	-43	-77
39.6664	-104.9396	-99	-52	-62	-49	-45	-75
39.6663	-104.9396	-97	-55	-64	-50	-46	-75
39.6661	-104.9396	-103	-56	-64	-47	-58	-75
39.6659	-104.9396	-101	-59	-64	-46	-52	-77
39.6657	-104.9396	-97	-58	-64	-46	-57	-76
39.6676	-104.9345	-94	-54	-65	-53	-72	-89
39.6676	-104.9347	-85	-51	-65	-53	-73	-89
39.6676	-104.9351	-86	-48	-65	-53	-73	-90
39.6675	-104.9356	-88	-51	-65	-53	-66	-90
39.6675	-104.9362	-91	-36	-65	-53	-64	-87
39.6676	-104.9367	-97	-37	-63	-53	-65	-80
39.6679	-104.9373	-98	-38	-62	-53	-62	-81
39.6681	-104.9378	-84	-27	-61	-53	-57	-81
39.6682	-104.9384	-85	-28	-62	-51	-55	-81
39.6683	-104.9388	-87	-37	-64	-51	-57	-79
39.6683	-104.9391	-84	-45	-58	-50	-52	-74
39.6683	-104.9392	-85	-48	-54	-50	-51	-67
39.6682	-104.9392	-83	-44	-53	-49	-51	-70
39.6682	-104.9393	-90	-45	-58	-50	-51	-73
39.6682	-104.9397	-95	-52	-63	-46	-42	-66
39.6682	-104.9402	-101	-60	-61	-43	-42	-59
39.6683	-104.9406	-102	-60	-58	-37	-38	-61
39.6681	-104.9409	-101	-63	-60	-26	-46	-66
39.6679	-104.9409	-99	-64	-58	-25	-51	-67
39.6677	-104.9409	-95	-65	-59	-24	-49	-67
39.6676	-104.9409	-96	-66	-63	-25	-49	-69
39.6676	-104.9411	-96	-65	-65	-31	-57	-71
39.6676	-104.9413	-95	-69	-65	-41	-52	-72

City and County of Denver 800 MHz Interference Measurements							
Site: Yale & Colorado							
Pericle Communications Company							
Spring, 2003							
		Denver CCH	Nextel	Nextel	Nextel	AT&T	AT&T
Latitude	Longitude	854.9875	852.4125	863.4125	865.4375	870.2100	870.6000
39.6677	-104.9414	-98	-73	-65	-37	-51	-66
39.6679	-104.9414	-102	-71	-65	-27	-50	-68
39.6681	-104.9414	-105	-68	-65	-31	-49	-73
39.6682	-104.9414	-102	-75	-64	-41	-49	-69
39.6684	-104.9414	-99	-74	-63	-40	-57	-67
39.6684	-104.9414	-99	-71	-63	-34	-57	-65
39.6685	-104.9415	-93	-72	-61	-32	-56	-64
39.6685	-104.9416	-88	-70	-63	-31	-56	-67
39.6685	-104.9417	-92	-72	-60	-28	-56	-61
39.6686	-104.9418	-98	-76	-61	-35	-60	-57
39.6687	-104.9418	-98	-75	-61	-38	-63	-52
39.6689	-104.9418	-99	-77	-61	-41	-66	-58
39.6691	-104.9418	-99	-81	-57	-47	-65	-57
39.6692	-104.9418	-93	-79	-54	-45	-65	-53
39.6693	-104.9417	-90	-74	-52	-45	-67	-51
39.6693	-104.9417	-88	-77	-51	-44	-68	-53
-0.0167	-0.0167	-89	-77	-56	-44	-64	-51
39.6686	-104.9419	-90	-77	-64	-35	-60	-63
39.6685	-104.9421	-99	-79	-63	-34	-61	-55
39.6684	-104.9422	-98	-78	-63	-31	-64	-56
39.6682	-104.9423	-101	-78	-63	-36	-61	-56
39.6680	-104.9423	-102	-85	-62	-48	-67	-61
39.6679	-104.9423	-104	-80	-63	-48	-70	-67
39.6677	-104.9423	-99	-74	-65	-45	-68	-66
39.6676	-104.9423	-89	-72	-65	-44	-68	-67
39.6676	-104.9422	-80	-68	-65	-39	-67	-76
39.6675	-104.9419	-84	-70	-65	-40	-64	-79
39.6674	-104.9418	-99	-73	-65	-41	-63	-79
39.6672	-104.9418	-103	-75	-65	-40	-62	-77
39.6669	-104.9418	-103	-78	-65	-42	-52	-77
39.6666	-104.9418	-105	-77	-65	-44	-59	-67
39.6662	-104.9418	-106	-82	-65	-47	-64	-68
39.6659	-104.9418	-102	-83	-65	-49	-69	-71
39.6657	-104.9418	-101	-81	-65	-50	-66	-74
39.6656	-104.9418	-89	-78	-65	-49	-67	-73
39.6655	-104.9417	-81	-76	-65	-52	-75	-85
39.6655	-104.9413	-80	-73	-65	-52	-74	-85
39.6656	-104.9410	-81	-67	-65	-44	-63	-82
39.6656	-104.9409	-80	-63	-65	-48	-56	-69
39.6656	-104.9409	-80	-62	-64	-53	-53	-66
39.6656	-104.9409	-81	-67	-64	-40	-60	-75
39.6654	-104.9408	-100	-64	-65	-43	-63	-79
39.6650	-104.9408	-99	-67	-64	-45	-62	-77
39.6646	-104.9408	-98	-67	-65	-50	-57	-71
39.6642	-104.9408	-96	-70	-65	-52	-69	-74
39.6637	-104.9407	-102	-69	-65	-51	-73	-80
39.6631	-104.9408	-100	-74	-65	-51	-77	-86
39.6626	-104.9408	-100	-76	-65	-53	-74	-89
39.6622	-104.9408	-102	-75	-65	-53	-72	-86
39.6617	-104.9408	-102	-75	-65	-53	-73	-87
39.6613	-104.9408	-106	-80	-65	-53	-73	-85
39.6725	-104.9407	-102	-81	-44	-53	-77	-61

City and County of Denver 800 MHz Interference Measurements							
Site: Yale & Colorado							
Pericle Communications Company							
Spring, 2003							
		Denver CCH	Nextel	Nextel	Nextel	AT&T	AT&T
Latitude	Longitude	854.9875	852.4125	863.4125	865.4375	870.2100	870.6000
39.6729	-104.9407	-106	-81	-43	-53	-82	-65
39.6732	-104.9407	-98	-83	-42	-53	-81	-65
39.6734	-104.9407	-98	-85	-51	-53	-80	-66
39.6738	-104.9407	-106	-86	-54	-53	-78	-72
39.6741	-104.9407	-104	-85	-54	-53	-79	-72
39.6745	-104.9407	-102	-83	-56	-53	-78	-69
39.6749	-104.9407	-96	-84	-53	-53	-85	-77
39.6753	-104.9407	-102	-86	-49	-53	-87	-80
39.6757	-104.9407	-103	-87	-55	-53	-80	-78
39.6761	-104.9407	-99	-85	-56	-53	-80	-80
39.6765	-104.9407	-90	-87	-56	-53	-89	-83
39.6768	-104.9407	-100	-87	-57	-53	-90	-86

City and County of Denver 800 MHz Interference Measurements								
Site: 14th & Market								
Pericle Communications Company								
Spring, 2003								
		Denver CCH	Nextel	Nextel	Nextel	AT&T	AT&T	AT&T
Latitude	Longitude	854.9875	863.6375	864.4625	864.9125	869.55	869.76	870.12
39.7516	-104.9978	-83	-65	-63	-63	-89	-73	-83
39.7514	-104.9981	-85	-63	-63	-65	-84	-69	-83
39.7512	-104.9984	-83	-65	-64	-68	-86	-75	-84
39.7510	-104.9987	-81	-70	-62	-64	-89	-68	-84
39.7507	-104.9990	-84	-75	-58	-65	-83	-64	-82
39.7505	-104.9993	-84	-70	-55	-67	-81	-61	-83
39.7503	-104.9995	-83	-73	-55	-68	-83	-61	-86
39.7501	-104.9998	-82	-64	-56	-68	-76	-62	-85
39.7499	-105.3334	-85	-61	-54	-67	-73	-59	-84
39.7497	-105.0003	-80	-54	-53	-58	-71	-52	-75
39.7495	-105.0005	-80	-57	-53	-61	-65	-51	-79
39.7493	-105.0008	-76	-53	-60	-67	-62	-54	-80
39.7491	-105.0011	-75	-51	-62	-66	-60	-61	-80
39.7489	-105.0013	-65	-39	-59	-69	-52	-67	-74
39.7487	-105.0013	-64	-35	-63	-66	-49	-67	-74
39.7485	-105.0012	-62	-43	-65	-65	-52	-69	-68
39.7483	-105.0010	-61	-46	-63	-63	-55	-73	-60
39.7482	-105.0009	-62	-44	-67	-62	-52	-76	-61
39.7482	-105.0009	-54	-45	-64	-60	-52	-74	-61
39.7482	-105.0009	-58	-44	-63	-58	-51	-78	-59
39.7482	-105.0009	-63	-46	-62	-59	-55	-73	-62
39.7482	-105.0008	-61	-53	-55	-65	-55	-72	-61
39.7482	-105.0009	-60	-55	-55	-67	-54	-75	-61
39.7482	-105.0009	-61	-55	-55	-67	-54	-74	-61
39.7482	-105.0009	-60	-55	-55	-66	-54	-73	-61
39.7482	-105.0009	-60	-56	-55	-68	-54	-73	-61
39.7482	-105.0009	-61	-54	-54	-67	-54	-74	-61
39.7482	-105.0008	-63	-48	-58	-59	-59	-75	-57
39.7482	-105.0007	-60	-52	-47	-56	-60	-72	-51
39.7483	-105.0004	-65	-55	-55	-58	-65	-69	-55
39.7485	-105.0002	-71	-59	-53	-52	-72	-68	-61
39.7487	-105.1666	-72	-59	-48	-52	-73	-62	-62
39.7488	-104.9998	-72	-61	-49	-49	-76	-60	-59
39.7488	-104.9997	-70	-55	-49	-46	-84	-61	-53
39.7488	-104.9997	-69	-55	-49	-45	-88	-60	-53
39.7488	-104.9997	-69	-55	-49	-45	-89	-61	-53
39.7488	-104.9997	-70	-55	-49	-45	-89	-61	-53
39.7488	-104.9997	-73	-56	-47	-46	-79	-61	-58
39.7488	-104.9997	-69	-57	-41	-43	-77	-62	-60
39.7488	-104.9997	-68	-58	-40	-45	-75	-61	-59
39.7488	-104.9997	-77	-64	-47	-51	-74	-60	-61
39.7490	-104.9996	-77	-65	-47	-48	-75	-62	-65
39.7492	-104.9993	-82	-64	-46	-47	-75	-63	-63
39.7494	-104.9991	-85	-66	-43	-47	-78	-60	-62
39.7496	-104.9987	-84	-71	-37	-46	-84	-67	-61
39.7499	-104.9984	-82	-71	-30	-45	-87	-68	-59
39.7501	-104.9981	-79	-74	-31	-45	-89	-71	-62
39.7503	-104.9978	-81	-76	-33	-48	-90	-74	-65
39.7506	-104.9975	-81	-77	-37	-47	-90	-74	-70
39.7508	-104.9972	-83	-78	-39	-49	-90	-77	-69
39.7507	-104.9971	-83	-84	-52	-64	-90	-84	-82
39.7505	-104.9969	-83	-83	-57	-65	-90	-86	-86

City and County of Denver 800 MHz Interference Measurements								
Site: 14th & Market								
Pericle Communications Company								
Spring, 2003								
		Denver CCH	Nextel	Nextel	Nextel	AT&T	AT&T	AT&T
Latitude	Longitude	854.9875	863.6375	864.4625	864.9125	869.55	869.76	870.12
39.7504	-104.9968	-85	-83	-60	-64	-90	-89	-84
39.7503	-104.9967	-82	-79	-63	-66	-90	-84	-82
39.7503	-104.9966	-77	-77	-61	-65	-90	-80	-80
39.7503	-104.9966	-78	-77	-60	-66	-90	-80	-80
39.7503	-104.9966	-78	-76	-62	-65	-90	-81	-80
39.7503	-104.9966	-79	-76	-62	-65	-90	-80	-81
39.7503	-104.9966	-81	-79	-66	-69	-90	-82	-82
39.7503	-104.9966	-82	-83	-63	-66	-90	-86	-85
39.7502	-104.9966	-82	-82	-68	-64	-90	-88	-78
39.7501	-104.9965	-82	-81	-67	-61	-90	-86	-77
39.7498	-104.9968	-84	-80	-67	-58	-90	-88	-77
39.7496	-104.9970	-86	-78	-62	-56	-90	-83	-74
39.7494	-104.9973	-83	-76	-62	-56	-90	-82	-73
39.7491	-104.9977	-83	-76	-61	-51	-90	-83	-67
39.7488	-104.9980	-83	-78	-58	-49	-90	-86	-64
39.7486	-104.9982	-82	-77	-56	-44	-90	-81	-60
39.7484	-104.9985	-81	-75	-50	-35	-81	-74	-47
39.7482	-104.9988	-78	-72	-57	-45	-85	-75	-59
39.7480	-104.9990	-79	-68	-63	-50	-88	-87	-64
39.7479	-104.9992	-74	-67	-64	-51	-89	-88	-69
39.7477	-104.9994	-74	-65	-63	-54	-86	-89	-67
39.7476	-104.9996	-68	-62	-68	-57	-79	-88	-71
39.7474	-104.9997	-66	-57	-65	-54	-78	-90	-70
39.7474	-104.9998	-64	-59	-70	-58	-73	-86	-70
39.7472	-104.9996	-71	-62	-74	-65	-77	-90	-75
39.7471	-104.9994	-77	-63	-74	-64	-83	-90	-76
39.7469	-104.9992	-76	-67	-74	-61	-81	-87	-71
39.7469	-104.9991	-71	-73	-77	-64	-82	-88	-69
39.7469	-104.9991	-72	-76	-77	-67	-82	-88	-68
39.7469	-104.9991	-72	-75	-76	-66	-83	-89	-68
39.7469	-104.9991	-71	-74	-78	-66	-81	-88	-67
39.7469	-104.9991	-72	-73	-77	-66	-81	-88	-67
39.7469	-104.9991	-72	-75	-79	-67	-79	-88	-68
39.7469	-104.9991	-73	-75	-77	-66	-80	-89	-68
39.7469	-104.9991	-73	-77	-77	-66	-81	-90	-69
39.7469	-104.9991	-80	-67	-72	-72	-85	-83	-72
39.7469	-104.9991	-80	-66	-73	-64	-86	-86	-68
39.7469	-104.9990	-74	-66	-73	-59	-84	-88	-70
39.7470	-104.9988	-79	-69	-72	-60	-87	-89	-72
39.7471	-104.9985	-79	-70	-74	-58	-89	-90	-73
39.7473	-104.9982	-78	-74	-71	-54	-89	-90	-72
39.7475	-104.9980	-77	-76	-65	-49	-90	-86	-64
39.7475	-104.9980	-79	-73	-59	-48	-86	-82	-62
39.7476	-104.9979	-80	-71	-57	-45	-84	-81	-61
39.7476	-104.9980	-84	-71	-56	-44	-84	-81	-62
39.7476	-104.9979	-74	-72	-57	-48	-88	-80	-62
39.7477	-104.9978	-79	-73	-55	-39	-85	-74	-55
39.7479	-104.9975	-82	-75	-65	-48	-90	-88	-67
39.7481	-104.9973	-80	-78	-66	-54	-90	-89	-70
39.7482	-104.9970	-79	-76	-66	-57	-90	-90	-72
39.7483	-104.9969	-80	-75	-65	-56	-90	-89	-70
39.7484	-104.9968	-81	-76	-64	-53	-90	-88	-69

City and County of Denver 800 MHz Interference Measurements								
Site: 14th & Market								
Pericle Communications Company								
Spring, 2003								
		Denver CCH	Nextel	Nextel	Nextel	AT&T	AT&T	AT&T
Latitude	Longitude	854.9875	863.6375	864.4625	864.9125	869.55	869.76	870.12
39.7484	-104.9968	-81	-74	-61	-51	-90	-81	-64
39.7484	-104.9967	-80	-78	-65	-54	-90	-84	-70
39.7485	-104.9966	-82	-78	-56	-46	-90	-81	-63
39.7487	-104.9964	-85	-84	-65	-52	-90	-90	-68
39.7489	-104.9962	-86	-82	-71	-59	-90	-90	-75
39.7491	-104.9960	-85	-84	-69	-62	-90	-90	-82
39.7493	-104.9958	-82	-80	-68	-62	-90	-90	-85
39.7493	-104.9958	-81	-77	-64	-63	-90	-88	-82
39.7493	-104.9958	-79	-73	-60	-65	-90	-87	-83
39.7493	-104.9957	-80	-74	-61	-66	-90	-85	-83
39.7493	-104.9957	-82	-74	-62	-66	-90	-86	-82
39.7493	-104.9957	-82	-74	-62	-66	-90	-85	-81
39.7493	-104.9956	-80	-78	-65	-68	-90	-86	-83
39.7493	-104.9956	-81	-83	-69	-69	-90	-90	-82
39.7492	-104.9955	-84	-84	-71	-72	-90	-90	-86
39.7490	-104.9953	-82	-82	-71	-71	-90	-90	-86
39.7489	-104.9951	-83	-84	-72	-70	-90	-90	-85
39.7488	-104.9950	-74	-83	-75	-70	-90	-90	-83
39.7488	-104.9948	-75	-84	-73	-66	-90	-90	-78
39.7488	-104.9948	-77	-84	-77	-67	-90	-90	-78
39.7488	-104.9948	-78	-82	-77	-70	-90	-90	-85
39.7488	-104.9948	-78	-84	-77	-70	-90	-90	-84
39.7487	-104.9948	-80	-84	-79	-70	-90	-90	-85
39.7486	-104.9950	-80	-83	-78	-70	-90	-90	-85
39.7484	-104.9953	-80	-84	-76	-66	-90	-90	-82
39.7481	-104.9954	-85	-81	-76	-66	-90	-90	-82
39.7480	-104.9955	-79	-77	-72	-62	-90	-90	-77
39.7480	-104.9955	-76	-79	-68	-56	-90	-86	-72
39.7480	-104.9955	-77	-77	-66	-57	-90	-86	-71
39.7480	-104.9955	-79	-78	-66	-58	-90	-86	-70
39.7480	-104.9955	-83	-80	-69	-57	-90	-86	-73
39.7481	-104.9955	-79	-77	-71	-65	-90	-86	-72
39.7481	-104.9956	-77	-79	-68	-61	-90	-89	-74
39.7480	-104.9957	-81	-81	-67	-57	-90	-88	-75
39.7478	-104.9959	-79	-80	-69	-61	-90	-90	-78
39.7475	-104.9963	-73	-77	-76	-62	-90	-90	-80
39.7473	-104.9966	-78	-75	-72	-53	-90	-86	-74
39.7472	-104.9967	-77	-76	-68	-52	-87	-85	-69
39.7471	-104.9968	-76	-72	-74	-49	-83	-86	-65
39.7471	-104.9968	-75	-70	-69	-47	-82	-87	-63
39.7471	-104.9968	-76	-70	-69	-47	-82	-86	-63
39.7471	-104.9968	-75	-70	-70	-46	-82	-84	-63
39.7471	-104.9968	-75	-71	-68	-46	-82	-82	-63
39.7471	-104.9968	-76	-71	-69	-47	-82	-82	-63
39.7471	-104.9968	-76	-71	-70	-47	-82	-82	-63
39.7471	-104.9968	-75	-71	-71	-46	-82	-83	-63
39.7471	-104.9968	-77	-70	-70	-46	-83	-83	-63
39.7471	-104.9968	-77	-70	-67	-46	-82	-84	-63
39.7469	-104.9967	-77	-74	-54	-36	-89	-75	-66
39.7467	-104.9969	-80	-75	-68	-52	-90	-87	-68
39.7465	-104.9971	-81	-71	-71	-55	-88	-85	-69
39.7463	-104.9974	-78	-69	-71	-60	-88	-89	-72

City and County of Denver 800 MHz Interference Measurements								
Site: 14th & Market								
Pericle Communications Company								
Spring, 2003								
		Denver CCH	Nextel	Nextel	Nextel	AT&T	AT&T	AT&T
Latitude	Longitude	854.9875	863.6375	864.4625	864.9125	869.55	869.76	870.12
39.7461	-104.9977	-78	-66	-72	-57	-87	-88	-68
39.7460	-104.9978	-71	-66	-72	-58	-82	-88	-63
39.7461	-104.9979	-73	-69	-73	-58	-82	-90	-64
39.7461	-104.9980	-76	-68	-71	-60	-83	-90	-65
39.7459	-104.9982	-70	-69	-77	-64	-85	-90	-66
39.7458	-104.9985	-68	-69	-80	-68	-87	-90	-81
39.7455	-104.9988	-76	-65	-79	-70	-86	-90	-84
39.7454	-104.9990	-64	-61	-77	-69	-82	-90	-81
39.7452	-104.9992	-69	-58	-75	-70	-77	-90	-74
39.7451	-104.9994	-72	-64	-77	-72	-80	-89	-74
39.7449	-104.9996	-73	-58	-76	-73	-79	-88	-77
39.7449	-104.9997	-74	-55	-74	-68	-75	-87	-76
39.7449	-104.9998	-69	-58	-73	-71	-75	-84	-74
39.7450	-104.9999	-64	-53	-68	-64	-72	-87	-66
39.7453	-105.4444	-67	-54	-68	-66	-76	-86	-67
39.7456	-105.0001	-76	-56	-73	-68	-71	-79	-69
39.7460	-105.0003	-78	-55	-73	-67	-68	-81	-57
39.7463	-105.0005	-72	-54	-70	-64	-63	-77	-59
39.7465	-105.0007	-60	-52	-68	-62	-64	-79	-60
39.7466	-105.0008	-55	-50	-69	-58	-67	-75	-58
39.7466	-105.0008	-55	-50	-70	-58	-65	-74	-60
39.7466	-105.0008	-54	-51	-70	-58	-66	-74	-60
39.7466	-105.0008	-54	-51	-70	-59	-65	-74	-60
39.7466	-105.0008	-55	-50	-69	-58	-67	-73	-60
39.7466	-105.0008	-55	-51	-70	-58	-67	-74	-60
39.7466	-105.0008	-55	-50	-70	-59	-64	-75	-60
39.7467	-105.0008	-60	-47	-66	-62	-59	-77	-59
39.7468	-105.0010	-65	-43	-66	-63	-59	-76	-54
39.7470	-105.0013	-67	-42	-64	-59	-60	-74	-59
39.7472	-105.0016	-61	-39	-61	-66	-57	-74	-63
39.7475	-105.0020	-58	-38	-61	-64	-55	-73	-69
39.7477	-105.0023	-61	-32	-61	-59	-52	-70	-72
39.7480	-105.0027	-66	-37	-63	-60	-57	-74	-69
39.7484	-105.0030	-62	-38	-65	-67	-56	-73	-75
39.7488	-105.0034	-77	-44	-74	-69	-59	-80	-75
39.7491	-105.0036	-62	-53	-75	-74	-66	-88	-86